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Energy Research Abstracts

Abstracts 1-2786

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UNITED STATES DEPARTMENT OF ENERGY

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ENERGY RESEARCH ABSTRACTS

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The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through an energy information system maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases, plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). ITIS also serves as a gateway to other government and commercial systems and provides information merging for customized information products. To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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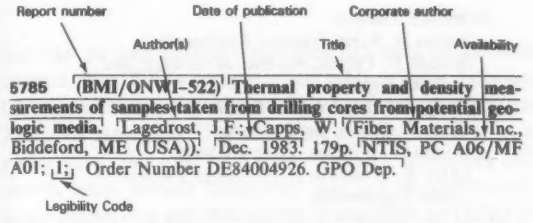
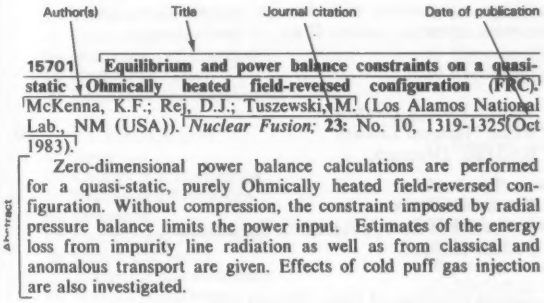
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; I; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI–522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI–522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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IEA Biomass Conversion Service
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IEA Coal Research
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Bethesda, MD

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Commack, NY

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

01 COAL AND COAL PRODUCTS
- 03 Preparation
- 04 Processing
- 05 By-Products
- 06 Properties
- 08 Waste Management
- 09 Environmental Aspects
- 10 Reserves and Exploration
- 20 Mining
- 30 Transport and Handling
- 40 Combustion
- 50 Marketing and Economics
- 60 Health and Safety
- 70 Legislation and Regulations

02 PETROLEUM
- 01 Reserves
- 02 Geology and Exploration
- 03 Drilling and Production
- 04 Processing
- 05 Products and By-Products
- 06 Health and Safety
- 07 Marketing and Economics
- 08 Waste Management
- 09 Environmental Aspects
- 10 Legislation and Regulation
- 20 Transport, Pipelines, and Handling
- 30 Properties
- 40 Storage
- 50 Combustion

03 NATURAL GAS
- 01 Reserves
- 02 Geology and Exploration
- 03 Drilling, Production, and Processing
- 04 Products and By-Products
- 05 Health and Safety
- 06 Marketing and Economics
- 07 Waste Management
- 08 Environmental Aspects
- 09 Artificial Stimulation
- 10 Legislation and Regulation
- 20 Transport, Pipelines, and Handling
- 30 Properties
- 40 Combustion
- 50 Storage

04 OIL SHALES AND TAR SANDS
- 01 Reserves and Exploration
- 02 Site Geology and Hydrology
- 03 Drilling, Fracturing, and Mining
- 04 Oil Production, Recovery, and Refining
- 05 Properties and Composition
- 06 Direct Uses and By-Products
- 07 Health and Safety
- 08 Marketing and Economics
- 09 Waste Research and Management
- 10 Environmental Aspects
- 20 Regulations

05 NUCLEAR FUELS
- 01 Reserves, Exploration, and Mining
- 04 Feed Processing
- 05 Uranium Enrichment
- 07 Fuels Production and Properties
- 08 Spent Fuels Reprocessing
- 09 Transport and Storage
- 10 Marketing, Economics, and By-Products
- 20 Waste Management
- 30 Environmental Aspects
- 40 Health and Safety
- 50 Safeguards, Inspection, and Accountability
- 60 Legislation and Regulations

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY
- 01 Physical Isotope Separation
- 02 Radiation Sources
- 03 Isotopic Power Supplies
- 04 Economics

08 HYDROGEN
- 01 Production
- 02 Storage
- 03 Transport
- 04 Marketing and Economics
- 05 Safety
- 06 Industrial and Commercial Use
- 07 By-Products
- 08 Properties
- 09 Environmental Aspects

09 OTHER SYNTHETIC AND NATURAL FUELS
- 01 Hydrocarbon Fuels
- 02 Alcohol Fuels
- 03 Inorganic Hydrogen Compound Fuels
- 04 Solid Waste and Wood Fuels
- 05 Liquid Waste Fuels
- 06 Gaseous Waste Fuels

13 HYDRO ENERGY
- 01 Resources and Availability
- 02 Site Geology and Meteorology
- 03 Plant Design and Operation
- 04 Regulations and Licensing
- 05 Economics and Management
- 06 Environmental Aspects
- 07 Power-Conversion Systems

14 SOLAR ENERGY
- 01 Resources and Availability
- 03 Economics
- 04 Environmental, Legal, and Institutional Aspects
- 05 Solar Energy Conversion
- 06 Photovoltaic Power Systems
- 07 Solar Thermal Power Systems
- 08 Ocean Energy Systems
- 09 Solar Thermal Utilization
- 10 Solar Collectors and Concentrators
- 20 Heat Storage

15 GEOTHERMAL ENERGY
- 01 Resource Status and Assessment
- 02 Geology and Hydrology of Geothermal Systems
- 03 Geothermal Exploration and Exploration Technology
- 04 Legal and Institutional Aspects
- 05 Economic and Financial Aspects
- 06 Environmental Aspects and Waste Disposal
- 07 By-Products
- 08 Geothermal Power Plants
- 09 Geothermal Engineering
- 10 Direct Energy Utilization
- 20 Geothermal Data and Theory

16 TIDAL AND WAVE POWER
- 03 Regulations
- 04 Economics
- 05 Environmental Aspects
- 07 Tidal Power Plants
- 08 Wave Energy Converters

17 WIND ENERGY
- 01 Availability (Climatology)
- 03 Regulations
- 04 Economics
- 05 Environmental Aspects
- 06 Wind Energy Engineering

20 ELECTRIC POWER ENGINEERING
- 01 Power Plants and Power Generation
- 02 Environmental Control Technology
- 03 Power Transmission and Distribution

21 NUCLEAR POWER PLANTS
- 01 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled
- 02 Power Reactors, Nonbreeding, Light-Water Moderated, Non-boiling Water Cooled
- 03 Power Reactors, Nonbreeding, Graphite Moderated
- 04 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated
- 05 Power Reactors, Breeding
- 06 Power Reactors, Auxiliary, Mobile, Package, and Transportable
- 07 Regulation and Licensing
- 08 Economics

22 NUCLEAR REACTOR TECHNOLOGY
- 01 Theory and Calculation
- 02 Components and Accessories
- 03 Fuel Elements
- 04 Control Systems
- 05 Environmental Aspects
- 06 Research, Test, and Experimental Reactors
- 07 Plutonium and Isotope Production Reactors
- 08 Propulsion Reactors
- 09 Reactor Safety

25 ENERGY STORAGE
- 01 Magnetic
- 02 Compressed Gas
- 03 Pumped Hydro
- 04 Capacitor Banks
- 05 Flywheels
- 06 Thermal
- 07 Liquefied Gas
- 08 Chemical
- 09 Batteries

29 ENERGY PLANNING AND POLICY
- 01 Energy Analysis and Modeling
- 02 Economics and Sociology
- 03 Environment, Health, and Safety
- 04 Natural Resources
- 05 Research, Development, Demonstration, and Commercialization
- 06 Nuclear Energy
- 07 Transport and Storage
- 08 Waste Heat Utilization
- 10 Conservation
- 20 Supply, Demand, and Forecasting
- 30 Policy, Legislation, and Regulation
- 40 Fossil Fuels
- 50 Hydrogen and Synthetic Fuels
- 60 Electric Power
- 80 Consumption and Utilization
- 90 Unconventional Sources and Power Generation

30 DIRECT ENERGY CONVERSION
- 01 MHD Generators
- 02 EHD Generators
- 03 Thermoelectric Generators
- 04 Thermionic Converters
- 05 Fuel Cells
- 08 Miscellaneous Converters

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION
- 01 Buildings
- 02 Transportation
- 03 Industry and Agriculture
- 06 Municipalities and Community Systems
- 09 Education and Public Relations

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS
- 01 Internal Combustion Engines
- 02 External Combustion Engines
- 03 Electric-Powered Systems
- 04 Hybrid Systems
- 05 Flywheel Propulsion
- 06 Vehicle Design Factors
- 07 Emission Control
- 08 Alternative Fuels

35 ARMS CONTROL
- 01 Policy, Negotiations, and Legislation
- 02 Proliferation
- 03 Verification

36 MATERIALS
- 01 Metals and Alloys
- 02 Ceramics, Cermets, and Refractories
- 06 Other Materials

40 CHEMISTRY
- 01 Analytical and Separations Chemistry
- 02 Inorganic, Organic, and Physical Chemistry
- 04 Electrochemistry
- 05 Photochemistry
- 06 Radiation Chemistry
- 07 Radiochemistry and Nuclear Chemistry
- 08 Combustion, Pyrolysis, and High-Temperature Chemistry

42 ENGINEERING
- 02 Facilities and Equipment
- 03 Lasers
- 04 Heat Transfer and Fluid Flow
- 05 Materials Testing
- 08 Electronic Circuits and Devices
- 09 Waste Processing Plants and Equipment
- 10 Combustion Systems
- 20 Underground Engineering
- 30 Marine Engineering
- 40 Pollution Control Equipment
- 50 Power Cycles

43 PARTICLE ACCELERATORS
- 01 Design, Development, and Operation
- 02 Beam Dynamics, Field Calculations, and Ion Optics
- 03 Auxiliaries and Components
- 04 Storage Rings

44 INSTRUMENTATION
- 01 Radiation Instrumentation
- 02 Radiation Effects on Instrument Components, Instruments, or Electronic Systems
- 03 Miscellaneous Instruments
- 04 Well Logging Instrumentation

45 EXPLOSIONS AND EXPLOSIVES
- 01 Chemical
- 02 Nuclear
- 03 Explosion Detection

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

52 ENVIRONMENTAL SCIENCES, AQUATIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

53 ENVIRONMENTAL—SOCIAL ASPECTS OF ENERGY TECHNOLOGIES
- 01 Social and Economic Studies
- 02 Assessment of Energy Technologies

55 BIOMEDICAL SCIENCES, BASIC STUDIES
- 01 Behavioral Biology
- 02 Biochemistry
- 03 Cytology

55 BIOMEDICAL SCIENCES, BASIC STUDIES (CONT.)
- 04 Genetics
- 05 Metabolism
- 06 Medicine
- 07 Microbiology
- 08 Morphology
- 09 Pathology
- 10 Physiological Systems
- 20 Public Health
- 30 Agriculture and Food Technology

56 BIOMEDICAL SCIENCES, APPLIED STUDIES
- 01 Radiation Effects
- 02 Thermal Effects
- 03 Chemicals Metabolism and Toxicology
- 04 Other Environmental Pollutant Effects

57 HEALTH AND SAFETY

58 GEOSCIENCES
- 01 Geology and Hydrology
- 02 Geophysics
- 03 Mineralogy, Petrology, and Rock Mechanics
- 04 Geochemistry
- 05 Oceanography

64 PHYSICS I
- 01 Astrophysics and Cosmology
- 02 Atmospheric Physics
- 03 Atomic, Molecular, and Chemical Physics
- 04 Fluid Physics
- 50 High Energy Physics

65 PHYSICS II
- 10 Nuclear Physics
- 12-20 Nuclear Properties and Reactions
- 30 Nuclear Theory
- 40 Radiation and Shielding Physics
- 50 Medical Physics
- 60 Condensed Matter Physics
- 61 Superconductivity
- 70 Theoretical and Mathematical Physics

70 FUSION ENERGY
- 01 Plasma Research
- 02 Fusion Power Plant Technology

99 GENERAL AND MISCELLANEOUS
- 01 Management
- 02 Mathematics and Computers
- 03 Information Handling
- 04 Law
- 05 Civilian Defense

CORPORATE AUTHOR INDEX

PERSONAL AUTHOR INDEX

SUBJECT INDEX

CONTRACT NUMBER INDEX

REPORT NUMBER INDEX

ORDER NUMBER CORRELATION

SUBJECT CONTENTS (ALPHABETICAL LISTING)

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33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS
- 08 Alternative Fuels
- 03 Electric-Powered Systems
- 07 Emission Control
- 02 External Combustion Engines
- 05 Flywheel Propulsion
- 04 Hybrid Systems
- 01 Internal Combustion Engines
- 06 Vehicle Design Factors

35 ARMS CONTROL
- 01 Policy, Negotiations, and Legislation
- 02 Proliferation
- 03 Verification

56 BIOMEDICAL SCIENCES, APPLIED STUDIES
- 03 Chemicals Metabolism and Toxicology
- 04 Other Environmental Pollutant Effects
- 01 Radiation Effects
- 02 Thermal Effects

55 BIOMEDICAL SCIENCES, BASIC STUDIES
- 30 Agriculture and Food Technology
- 01 Behavioral Biology
- 02 Biochemistry
- 03 Cytology
- 04 Genetics
- 06 Medicine
- 05 Metabolism
- 07 Microbiology
- 08 Morphology
- 09 Pathology
- 10 Physiological Systems
- 20 Public Health

40 CHEMISTRY
- 01 Analytical and Separations Chemistry
- 08 Combustion, Pyrolysis, and High-Temperature Chemistry
- 04 Electrochemistry
- 02 Inorganic, Organic, and Physical Chemistry
- 05 Photochemistry
- 06 Radiation Chemistry
- 07 Radiochemistry and Nuclear Chemistry

01 COAL AND COAL PRODUCTS
- 05 By-Products
- 40 Combustion
- 09 Environmental Aspects
- 60 Health and Safety
- 70 Legislation and Regulations
- 50 Marketing and Economics
- 20 Mining
- 03 Preparation
- 04 Processing
- 06 Properties
- 10 Reserves and Exploration
- 30 Transport and Handling
- 08 Waste Management

30 DIRECT ENERGY CONVERSION
- 02 EHD Generators
- 05 Fuel Cells
- 01 MHD Generators
- 08 Miscellaneous Converters
- 04 Thermionic Converters
- 03 Thermoelectric Generators

20 ELECTRIC POWER ENGINEERING
- 02 Environmental Control Technology
- 01 Power Plants and Power Generation
- 03 Power Transmission and Distribution

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION
- 01 Buildings
- 09 Education and Public Relations
- 03 Industry and Agriculture
- 06 Municipalities and Community Systems
- 02 Transportation

29 ENERGY PLANNING AND POLICY
- 10 Conservation
- 80 Consumption and Utilization
- 02 Economics and Sociology
- 60 Electric Power
- 01 Energy Analysis and Modeling
- 03 Environment, Health, and Safety
- 40 Fossil Fuels
- 50 Hydrogen and Synthetic Fuels
- 04 Natural Resources
- 06 Nuclear Energy
- 30 Policy, Legislation, and Regulation
- 05 Research, Development, Demonstration, and Commercialization
- 20 Supply, Demand, and Forecasting
- 07 Transport and Storage
- 90 Unconventional Sources and Power Generation
- 08 Waste Heat Utilization

25 ENERGY STORAGE
- 09 Batteries
- 04 Capacitor Banks
- 08 Chemical
- 02 Compressed Gas
- 05 Flywheels
- 07 Liquefied Gas
- 01 Magnetic
- 03 Pumped Hydro
- 06 Thermal

42 ENGINEERING
- 10 Combustion Systems
- 08 Electronic Circuits and Devices
- 02 Facilities and Equipment
- 04 Heat Transfer and Fluid Flow
- 03 Lasers
- 30 Marine Engineering
- 05 Materials Testing
- 40 Pollution Control Equipment
- 50 Power Cycles
- 20 Underground Engineering
- 09 Waste Processing Plants and Equipment

52 ENVIRONMENTAL SCIENCES, AQUATIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

53 ENVIRONMENTAL—SOCIAL ASPECTS OF ENERGY TECHNOLOGIES
- 02 Assessment of Energy Technologies
- 01 Social and Economic Studies

45 EXPLOSIONS AND EXPLOSIVES
- 01 Chemical
- 03 Explosion Detection
- 02 Nuclear

70 FUSION ENERGY
- 02 Fusion Power Plant Technology
- 01 Plasma Research

99 GENERAL AND MISCELLANEOUS
- 05 Civilian Defense
- 03 Information Handling
- 04 Law
- 01 Management
- 02 Mathematics and Computers

58 GEOSCIENCES
- 04 Geochemistry
- 01 Geology and Hydrology
- 02 Geophysics
- 03 Mineralogy, Petrology, and Rock Mechanics
- 05 Oceanography

15 GEOTHERMAL ENERGY
- 07 By-Products
- 10 Direct Energy Utilization
- 05 Economic and Financial Aspects
- 06 Environmental Aspects and Waste Disposal
- 02 Geology and Hydrology of Geothermal Systems
- 20 Geothermal Data and Theory
- 09 Geothermal Engineering
- 03 Geothermal Exploration and Exploration Technology
- 08 Geothermal Power Plants
- 04 Legal and Institutional Aspects
- 01 Resource Status and Assessment

57 HEALTH AND SAFETY

13 HYDRO ENERGY
- 05 Economics and Management
- 06 Environmental Aspects
- 03 Plant Design and Operation
- 07 Power-Conversion Systems
- 04 Regulations and Licensing
- 01 Resources and Availability
- 02 Site Geology and Meteorology

08 HYDROGEN
- 07 By-Products
- 09 Environmental Aspects
- 06 Industrial and Commercial Use
- 04 Marketing and Economics
- 01 Production
- 08 Properties
- 05 Safety
- 02 Storage
- 03 Transport

44 INSTRUMENTATION
- 03 Miscellaneous Instruments
- 02 Radiation Effects on Instrument Components, Instruments, or Electronic Systems
- 01 Radiation Instrumentation
- 04 Well Logging Instrumentation

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY
- 04 Economics
- 03 Isotopic Power Supplies
- 01 Physical Isotope Separation
- 02 Radiation Sources

36 MATERIALS
- 02 Ceramics, Cermets, and Refractories
- 01 Metals and Alloys
- 06 Other Materials

03 NATURAL GAS
- 09 Artificial Stimulation
- 40 Combustion
- 03 Drilling, Production, and Processing
- 08 Environmental Aspects
- 02 Geology and Exploration
- 05 Health and Safety
- 10 Legislation and Regulation
- 06 Marketing and Economics
- 04 Products and By-Products
- 30 Properties
- 01 Reserves
- 50 Storage
- 20 Transport, Pipelines, and Handling
- 07 Waste Management

05 NUCLEAR FUELS
- 30 Environmental Aspects
- 04 Feed Processing
- 07 Fuels Production and Properties
- 40 Health and Safety
- 60 Legislation and Regulations
- 10 Marketing, Economics, and By-Products
- 01 Reserves, Exploration, and Mining
- 50 Safeguards, Inspection, and Accountability
- 08 Spent Fuels Reprocessing
- 09 Transport and Storage
- 05 Uranium Enrichment
- 20 Waste Management

21 NUCLEAR POWER PLANTS
- 08 Economics
- 06 Power Reactors, Auxiliary, Mobile, Package, and Transportable
- 05 Power Reactors, Breeding
- 03 Power Reactors, Nonbreeding, Graphite Moderated
- 01 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled
- 02 Power Reactors, Nonbreeding, Light-Water Moderated, Non-boiling Water Cooled
- 04 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated
- 07 Regulation and Licensing

22 NUCLEAR REACTOR TECHNOLOGY
- 02 Components and Accessories
- 04 Control Systems
- 05 Environmental Aspects
- 03 Fuel Elements
- 07 Plutonium and Isotope Production Reactors
- 08 Propulsion Reactors
- 09 Reactor Safety
- 06 Research, Test, and Experimental Reactors
- 01 Theory and Calculation

04 OIL SHALES AND TAR SANDS
- 06 Direct Uses and By-Products
- 03 Drilling, Fracturing, and Mining
- 10 Environmental Aspects
- 07 Health and Safety
- 08 Marketing and Economics
- 04 Oil Production, Recovery, and Refining
- 05 Properties and Composition
- 20 Regulations
- 01 Reserves and Exploration
- 02 Site Geology and Hydrology
- 09 Waste Research and Management

09 OTHER SYNTHETIC AND NATURAL FUELS
- 02 Alcohol Fuels
- 06 Gaseous Waste Fuels
- 01 Hydrocarbon Fuels
- 03 Inorganic Hydrogen Compound Fuels
- 05 Liquid Waste Fuels
- 04 Solid Waste and Wood Fuels

43 PARTICLE ACCELERATORS
- 03 Auxiliaries and Components
- 02 Beam Dynamics, Field Calculations, and Ion Optics
- 01 Design, Development, and Operation
- 04 Storage Rings

02 PETROLEUM
- 50 Combustion
- 03 Drilling and Production
- 09 Environmental Aspects
- 02 Geology and Exploration
- 06 Health and Safety
- 10 Legislation and Regulation
- 07 Marketing and Economics
- 04 Processing
- 05 Products and By-Products
- 30 Properties
- 01 Reserves
- 40 Storage
- 20 Transport, Pipelines, and Handling
- 08 Waste Management

64 PHYSICS I
- 01 Astrophysics and Cosmology
- 02 Atmospheric Physics
- 03 Atomic, Molecular, and Chemical Physics
- 04 Fluid Physics
- 50 High Energy Physics

65 PHYSICS II
- 60 Condensed Matter Physics
- 50 Medical Physics
- 10 Nuclear Physics
- 12-20 Nuclear Properties and Reactions
- 30 Nuclear Theory
- 40 Radiation and Shielding Physics
- 61 Superconductivity
- 70 Theoretical and Mathematical Physics

14 SOLAR ENERGY
- 03 Economics
- 04 Environmental, Legal, and Institutional Aspects
- 20 Heat Storage
- 08 Ocean Energy Systems
- 06 Photovoltaic Power Systems
- 01 Resources and Availability
- 10 Solar Collectors and Concentrators
- 05 Solar Energy Conversion
- 07 Solar Thermal Power Systems
- 09 Solar Thermal Utilization

16 TIDAL AND WAVE POWER
- 04 Economics
- 05 Environmental Aspects
- 03 Regulations
- 07 Tidal Power Plants
- 08 Wave Energy Converters

17 WIND ENERGY
- 01 Availability (Climatology)
- 04 Economics
- 05 Environmental Aspects
- 03 Regulations
- 06 Wind Energy Engineering

CORPORATE AUTHOR INDEX

PERSONAL AUTHOR INDEX

SUBJECT INDEX

CONTRACT NUMBER INDEX

REPORT NUMBER INDEX

ORDER NUMBER CORRELATION

ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

1 **(ORNL—6395) Fossil Energy Program: Semiannual progress report, October 1986-March 1987.** Bradley, R.A. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 159p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001494/JAW.

This report covers progress made during the period October 1, 1986, through March 31, 1987, for research and development projects that contribute to the advancement of various fossil energy technologies. Projects on the Fossil Energy Program are supported by DOE Office of Fossil Energy, DOE Office of Basic Energy Sciences, and the Tennessee Valley Authority.

0103 Preparation

REFER ALSO TO CITATION(S) 61, 67, 74, 122, 148

2 **(BMFT-FB-T—86-255) Research concerning preparation of low carbonized coal high in ash and sulphur of a Spanish deposit. Final report.** Bartelt, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Montan-Consulting G.m.b.H., Essen (Germany, F.R.)). Dec 1986. 27p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753260/JAW.

1. Present state of investigations: Finalized in the 1st quarter of 1986; 2. Description/task of investigations: Emission control by reduction of steam coal sulphur contents by means of preparation techniques; 3. Method: raw coal quality analyses, preparability tests in testing facilities, evaluation of test results and elaboration of planning parameters for the design of a coal preparation plant, elaboration of a feasibility study on practical application and operation of a coal preparation plant and basic engineering for the selected alternative; 4. Results: Construction of the coal preparation plant, throughput rate: 500 t/h, start-up: 1987. With 1 tab., 4 figs.

3 (CONF-8610247—, pp 23-29) **Clean coal technology demonstration program.** Bauer, D.L. (Dept. of Energy, Washington, DC). 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

Public Law 99-190 passed in December, 1985 provided funding for cost-shared clean coal technology demonstration programs. Fifty-one proposals were submitted that met the qualification criteria. The projects involved coal preparation, fluidized-bed combustion, coal gasification, and flue gas cleanup concepts. Nine programs were selected for initial funding, while another 14 were put on a second list in case negotiations with the first nine were not successful. In the meantime, a report from the US and Canadian special envoys was released detailing their findings on acid rain and their recommendations for pollution control. While admitting that the nine projects selected under the Clean Coal program may not have been the ones selected if Congress had directed DOE to use the Special Envoys' recommendations, this paper summarizes how the nine projects will accomplish many of the objectives of the Special Envoys' report.

4 (DOE/METC—87/6081, pp 1.A1-1.A16) **Desulfurization of low rank Turkish coals by flotation.** Demirel, H.; Erten, M.H. (Univ. of Missouri, Rolla). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The unstable oil prices made low rank coals an alternative energy source. However, high sulfur coals need to be desulfurized before they can be used because they use air pollution. In this research, the preliminary tests were conducted on coal samples obtained from the Beypazari Mines in Turkey. These mines contain two seams, designated as upper and lower coal seams. The tests on these coals indicated the possibility of reducing the pyritic sulfur by two stage flotation process. Microscopic studies showed that the pyrite is finely disseminated in these coals and it could only be liberated in fine size range. The conventional flotation process was conducted on each sample utilizing kerosene and MIBC. In order to further liberate the pyrite, the froth concentrate was then wet ground to -200/0 mesh size. Then a second stage reverse flotation was applied by depressing the coal and floating the pyrite. By using the above process, the pyritic sulfur content was reduced from 3.81% to 1.03% for upper coal seam and from 3.21% to 0.96% for lower coal seam with 60.5% coal recovery. From this study second stage reverse flotation appears to give promising results. 13 references, 2 figures, 7 tables.

5 (DOE/METC—87/6081, pp 4.A2.1-4.A2.18) **Effect of coal cleaning on the combustion performance characteristics of big brown lignite.** Durant, J.F.; Lexa, G.F.; Levasseur, A.A.; Mehta, A.K.; Baumann, P.D. (Combustion Engineering, Inc., Windsor, CT). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Texas Utilities Electric Company (TU Electric) and the Electric Power Research Institute (EPRI) co-sponsored a comprehensive research program to assess the feasibility of physically cleaning Wilcox Formation lignite to improve power plant performance. Under this program, lignite from the Big Brown Mine and cleaned lignite produced at EPRI's Coal Cleaning Test Facility were studied. The impacts of coal cleaning on boiler fireside performance were evaluated during a series of bench-scale and pilot-scale combustion tests conducted by Combustion Engineering at their Kreisinger Development Laboratory. Results of this evaluation show that coal cleaning has beneficial effects on several areas of fuel-related performance. Mill wear potential and grinding energy requirements were reduced for the cleaned lignite. Contrary to predictions based on commonly used bench-scale indicators, pilot-scale combustion results showed improved ash slagging and fouling behavior. Fly ash erosion potential decreased significantly due to cleaning. The performance benefits of the cleaned lignite can be translated into potential operating savings from maintenance cost reductions due primarily to longer component life. Additional benefits can come from improved plant heat rate due mainly to lower pulverized power consumption, and reduced sootblower medium consumption, and from estimated increases in unit availability. 10 references, 6 figures, 7 tables.

6 (DOE/METC—87/6081, pp 7.A1.1-7.A1.17) **Assessing potential benefits and penalties of cleaning low-rank coals.** Suardini, P.; Akers, D.J.; Hancock, C. (Kaiser Engineers, Inc., Homer City, PA). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Approximately 70% of the eastern bituminous coal burned to generate electricity is physically cleaned in some manner prior to combustion. Therefore, a substantial amount of coal cleaning plant operating data and coal cleaning-related reserve information is available for most eastern bituminous coal seams. In contrast, only 4% of low-rank, western coal is presently being cleaned, and limited information is available assessing the response of this coal to

physical cleaning. This paper outlines the general advantages and disadvantages of coal cleaning for existing low-rank coal mining and power plant operations. It also discusses procedures for evaluating the cleaning characteristics of low-rank coals. Results from cleaning investigations on three low-rank coals, one Robinson Seam subbituminous from investigations on three low-rank coals, one Robinson Seam subbituminous from Montana and two Wilcox Formation lignites from Texas, are used as examples. 7 references, 2 figures, 6 tables.

7 (DOE/METC—87/6081, pp 7.A2.1-7.A2.14) **Thermal treatment of low-rank coal and its relationship to flotation response.** Ye, Y.; Jin, R.; Miller, J.D. (Univ. of Utah, Salt Lake City). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The deleterious effect of oxidation processes on coal flotation is generally recognized by researchers in the field. The present study, however, demonstrates that properly controlled low-temperature heating can actually improve coal flotation and its separation from mineral matter especially for low-rank coals. With a lignite sample, low-temperature heating at 130°C for a given time under ambient atmosphere leads to a higher yield and greater ash rejection during subsequent bench-scale flotation experiments. By combining experimental results from Hallimond-tube and bench-scale flotation experiments, bubble attachment-time measurements, wetting phenomena, and FTIR spectroscopy, it is clear that thermal treatment under the above conditions, which involves dehydration and oxidation reactions, changes the coal sample to a more hydrophobic state. These new results provide further evidence of the complexities involved in the analysis of coal surface chemistry as related to flotation phenomena. 31 references, 8 figures, 4 tables.

8 (DOE/METC—87/6081, pp 7.A3.1-7.A3.15) **Combined ultrafine grinding and drying of a low rank coal.** Steele, W.G.; Bouchillon, C.W. (Mississippi State Univ.). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

An experimental evaluation of combined ultrafine grinding and drying of a Martin Lake, Texas lignite has been made. Analysis of the energy requirements for the process, determination of various properties of the product, and evaluation of ash isolation are presented in this paper. A sample of a Martin Lake, Texas lignite was obtained and a series of tests were conducted in a fluid-energy mill at the development facility of the Micro-Energy Division of Ergon, Inc. in Vicksburg, MS. The grinding fluids used were air at 116°F and steam at 225, 310, 350, 400 and 488°F as measured in the mill. The products of these tests were analyzed for volatile matter, ash, total moisture, equilibrium moisture, heating value, density distribution, aerodynamic particle size classification, angle of repose, porosity, density, and particle size distribution. The mill was instrumented and measurements were made to determine the energy requirements for the process. Ultimate analyses and ash mineral content analyses were also made. In general, the fluid-energy mill was used successfully in simultaneous ultrafine grinding and drying of the lignite. Particle size reduction to less than 10 microns on a population basis was achieved. The equilibrium moisture of the samples decreased with increasing grinding fluid temperature. Density distribution studies showed that a significant fraction of the ground particles were ash rich. This ash rich fraction was about 2% of the mass of the sample and contained approximately 50% of the ash in the sample. The energy required for the process increased with increasing temperature.

9 (DOE/METC—87/6081, pp 7.B2.1-7.B2.15) **Benefits of partial moisture reduction of high moisture fuels on power plant performance, operations and maintenance.** Seabury, S.W. (GUS, Inc., Dallas, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Moisture reduction of high moisture fuels prior to delivery into steam generator silo storage can extensively effect unit performance. It can be shown that benefits result throughout all phases of the fuel cycle. The major consideration is to control the magnitude of moisture reduction to an optimum point. Drying fuel past the optimum point can lead to a reduction in unit performance and unacceptable dust generation. Drying equipment can be retrofitted into plant operations without interfering with unit generation. Combined fuel cycle operation can result in favorable financial analysis even where fuel transportation savings are not taken into account. 4 references, 2 figures, 8 tables.

10 (DOE/METC—87/6081, pp 3.C2.1-3.C2.14) **ENDESA's achievements on low rank coal utilization at Teruel, Spain.** Calvo, J.; Menendez, E. (ENDESA, Madrid, Spain). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

ENDESA's role in the Spanish energy field is presented, which last year was 50% of the coal market and 32% of the total electricity production in Spain. Among ENDESA's power plants, C.T. Teruel is located on a low rank, high sulfur coal basin. Studies on coal preparation and clean combustion have been developed to enable coal mining and power plant work under pollution limits. The decisions take are presented in this paper: short term: blending with high quality coal and natural gas; medium term: 500 t/h washing plant; long term: pressurized fluidized bed combustion boilers. 4 figures. 8 tables.

11 (DOE/METC—87/6081, pp PS.2) **Clean, low-rank coal slurry fuels.** Dewall, R. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

A process using hydrothermal treatment (HT) of coal has produced high-energy density fuels. In this process, the coal is treated at elevated temperature and pressure to remove the inherent moisture and modify the surface properties of the low-rank coals. Depending on the amount of moisture in the raw coal, the process allows the coal to be slurried in its own water. By removing the inherent moisture of the coal, hydrothermal treatment allows highly concentrated coal/water fuels to be prepared from low-rank coals. This is complemented by incorporating communition steps, to obtain an optimal coal particle size distribution in the coal/water fuel production scheme to further enhance coal concentration. Slurry fuels with up to 8000 Btu/pound have been prepared after HT from low-rank coals. Any further concentration and stabilization of the fuel required the use of additives. Research is continuing in all areas of HT fuel slurry enhancement. Chemical cleaning using acid leaching has shown the most success as a second step, following physical cleaning, in the preparation of clean low-rank coal. In the acid leaching step the mineral matter is removed from the physically cleaned coal by mixing with dilute acid and filtering to recover the clean coal. The clean coal is then hydrothermally treated, and high-energy slurry fuels are prepared. Coal/water fuels from low-rank coals can be produced by integrating the steps of physical cleaning, chemical cleaning, hydrothermal treatment, optimum sizing and proper additives in an advanced preparation process. These clean high solids content slurry fuels would then be suitable for use in residential furnaces and in advanced combustion systems.

12 **(DOE/PC/80525—T8) Three-dimensional structure of flow in coal-cleaning cyclones: Technical progress report No. 8, June 1, 1987-August 31, 1987.** Hwang, C.C.; Chiu, C.L. (Pittsburgh Univ., PA (USA). School of Engineering). 9 Oct 1987. Contract FG22-85PC80525. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000934/JAW.

This the eighth Technical Progress Report for the project "Three Dimensional Structure of Flow in Coal-Cleaning Cyclones" under Grant No. FG22-85PC80525. During the eighth report period, major tasks included: (1) continuation of the refinement of modeling technique, using experimental data, (2) continuation of measurements of the velocity distributions within the model cyclone A (vertex angle 30 degrees), and (3) similar measurements within the model cyclone B (vertex angle 11 degrees) which was newly fabricated. The data revealed that the distribution of the lon-

gitudinal flow velocity has a typical pattern shown in Fig. 1. The earlier version of mathematical model was not capable of simulating the pattern. Figure 1 shows the measured data of velocity distribution along with the computed results (the smooth curves shown) with the refined mathematical model. The refined model can simulate the pattern of axial flow velocity distribution shown in Fig. 1, in which the locations of both the "mantle" (an imaginary surface in a cyclone along which both the axial and radial velocities are zero) and the maximum tangential velocity can be automatically determined. 7 figs.

13 **(DOE/PC/90536—T4) Autogenous process for low-ash and low-sulfur coal production: Technical progress report, July 1, 1987-September 30, 1987.** Hu, W.; Rajamani, K. (Utah Univ., Salt Lake City (USA)). 1987. Contract FG22-86PC90536. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000781/JAW.

We continued performing measurements of zeta potential and the height of the froth layer and bubble size under different salt-flotation conditions, to delineate the mechanisms of salt action during coal flotation. The results show that the zeta-potential of the coal surface will decrease with salt concentration of LiCl, NaCl, $CaCl_2$, $MgCl_2$, and $BaCl_2$, except in $FeCl_3$ and $AlCl_3$ solution. The height of the froth layer will increase with the salt concentration. The surface tension and specific gravity also increase with salt concentration; the bubble size will decrease with increase of salt solution. Based on these correlations of floatability of coal with salt concentration, three mechanisms have been suggested: (1) the formation of a more stable froth layer and smaller bubble size; (2) changing the zeta potential of the coal surface in terms of the change in the properties of the hydrate film and double layer of the coal solution interface; and (3) salting-out effect. The floatability of the three coal samples was investigated by maceral analysis, ultimate analysis, FTIR examination, and froth flotation tests. The floatability of Bruceton coal is much higher than raw and oxidized Illinois No. 6 coals. It can be correlated with the greater number of liptinite groups in Bruceton coal (~21.3%) than in Illinois No. 6 coal (~0.5%). Besides, Bruceton coal is less hydrophilic due to fewer -OH, -O-, and -COOH groups and a lower O/C atomic ratio as confirmed by FTIR spectroanalysis. The wetting behavior of water and kerosene on the raw coal sample and oxidized coal has been studied by immersion wettability and capillary rise method (contact-angle measurement of ultrafine particle).

14 **(NP—8750422) Dehydrating briquetting under addition of lime for the production of a lump-size environmentally acceptable fuel from coal. Final report.** Lehmann, J.; Makrutzki, D.; Bogenschneider, B. (Ruhrkohle A.G., Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Mar 1987. 47p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750422/JAW.

In the process of dehydrating agglomeration of coal slurries bituminous substances of varying origin can be used as coal surface wetting agent and as binder. Addition of hydrated lime results in an environmentally acceptable combustion in industrial firing plants. The grain size of the feed coal has a strong influence on the dewatering effect during briquetting; coarser flotation concentrates are easier to dehydrate and compress to briquettes of higher mechanical strength than the finer concentrates. The required compresssion time also depends on the feed size and in any case is longer than with the conventional hard coal briquetting for the household market. As at present there is no sales potential for the new fuel the development activities have been finished upon completion of the basic laboratory experiments. With 2 refs., 13 tabs., 6 figs.

15 **Increased value of refined high sulfur coal.** Dugan, P.R. (Dept. of Biotechnology, Idaho National Engineering Lab., Idaho Falls, ID). *Mining Engineering (Littleton, Colorado);* **39**: No. 8, 804-806(Aug 1987).

Sulfur removal from high sulfur coal has several objectives including: a) reduction of the atmospheric load that contributes to the problem of acid precipitation; b) reduction of ash, which contributes to decreased energy transfer in boilers, as well as ash disposal; and c) alleviation of the social and economic dislocations related to uneven geographical distribution of sulfur in coal reserves. Cost in relation to the value of refined coal will govern the development of an emerging coal refining industry. Estimation of the premium paid by power companies for coal with a low sulfur content is a good estimate of the value that will be added as the result of refining. Estimates of premiums paid in 1984 are $28,65/t ($26 per st) for reduction of total sulfur from 3% to 1% S and greater than $28.65/t ($26 per st) for removal below 1% sulfur.

0104 Processing

REFER ALSO TO CITATION(S) 3, 11, 50, 57, 62, 65, 66, 74, 74, 75, 81, 81, 111, 147, 147, 150, 152, 154, 166, 168, 195, 264, 453, 607, 612, 615

16 (CONF-8610247—, pp 87-108) **Coal gasification for utility application.** Straughan, I. (Southern California Edison Co.). 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

As concerns about the environment increase and regulations on permissible emissions become more stringent, coal consumption in existing as well as new generating plants will be constrained. This paper describes the advantages of a proven technology which has successfully demonstrated that coal-to-electricity conversion need not be dirty nor prohibitively expensive. The technology is Integrated Gasification Combined-Cycle (IGCC). It offers additional advantages, which taken together, makes IGCC a strong candidate for future utility applications world wide. The paper is divided into four sections. Section One provides a brief historical perspective. Section two describes the new utility generation planning environment. Section Three presents Southern California Edison's experience with IGCC. Section Four outlines other advantages of IGCC and the interest it has generated among utilities. 9 figures, 2 tables.

17 **(DOE/ER/13392—T1) Direct alcohol synthesis using modified cobalt catalysts: Final project report covering the period 7/15/85-7/14/87.** Griffin, G.L. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 25 Sep 1987. Contract FG02-85ER13392. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000382/JAW.

We have studied the preparation and characterization of mixed Cu-Co-ZnO catalysts, and tested the activity of these catalyst for direct synthesis of methanol and higher molecular weight alcohols. Our primary goal is to understand and control the factors which determine the selectivity of these catalysts. We have prepared a series of binary and ternary compositions using both sequential and simultaneous precipitation methods, both with and without alkali promoters. We have used temperature programmed desorption techniques to measure the concentration and adsorption energy of sites on the individual components of the catalyst surface, using H_2 and CO as adsorbates. Work completed to date has shown that both adsorbates are useful for correlating the CH_3OH synthesis activity of Cu/ZnO binary catalysts. Experiments have also shown that the CH_3OH synthesis activity of the binary catalysts correlates with Cu surface area, which in turn is sensitive to the precipitation method used to prepare the catalysts. We have also performed mechanistic studies which show that the rate limiting step in CH_3OH synthesis must be the hydrogenation of either the formyl or formate intermediate. 33 refs., 3 figs., 1 tab.

18 **(DOE/MC/21225—2403) Wet carbonization of lump-size low-rank coals by a novel non-slurry approach: Final report for the period August 1, 1984-March 31, 1987.** Conrad, J.R.; Grimes, J.G.; Henry, M.P.; Janulis, J.A.; Lau, F.S.; Laurens, R.M.; Mensinger, J.D.; Mensinger, M.C.; Punwani, D.V.; Roberts, M.J. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1987. Contract AC21-84MC21225. 352p. NTIS, PC A16. Order Number DE87014662/JAW.

Wet carbonization is a thermochemical process for beneficiating low-rank coals by heating the coal in the presence of water to temperatures in the range of 400° to 650°F. Wet carbonization produces a low-rank coal product with a higher heating value,

lower equilibrium moisture content, lower sodium content, and better handling properties than the raw coal. The low moisture and high heating value of the fuel reduces transportation and handling costs. It also improves the economics of several gasification systems. In addition, combustion efficiencies are also improved, which makes them competitive with desulfurized high-rank coals. The reduction of sodium content in the low-rank coal will also reduce fouling and slagging problems in boilers. The results show that wet carbonization of lump-size low-rank coals is an effective process for significantly reducing the equilibrium moisture content (down to 11%) and sodium contents (by 80%), while increasing the calorific value of the wet-carbonized coal by as much as 16%. Laboratory-scale tests were conducted to determine the effectiveness of using anaerobic digestion for reducing the chemical and biological oxygen demand of the product water and for energy recovery in the form of by-product methane. The results of the anaerobic digestion experiments show that the product water is effectively treated in a two-stage system with a chemical oxygen demand (COD) reduction of 74% and a biological oxygen demand (BOD) reduction of 97%. About 99% of the heavy organics (2 to 3 ring chemical compounds) are degraded during anaerobic digestion. The results from the activated sludge treatment show that further reduction in the COD and BOD to approximately 80% to 100%, respectively, is possible. 11 refs., 80 figs., 55 tabs.

19 (DOE/MC/23089—2354) **Dynamic simulation models for high-temperature desulfurization processes: Technical progress report.** Harrison, D.P.; Groves, F.R. Jr. (Louisiana State Univ., Baton Rouge (USA). Dept. of Chemical Engineering). Apr 1987. Contract AC21-86MC23089. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE87006486/JAW.

This technical progress report is submitted in partial fulfillment of contract requirements and covers the first six months of project activities. The overall project is divided into two primary tasks with the second containing a number of subtasks. This technical progress report is organized in accordance with the project tasks and subtasks. In brief, the project objectives are to prepare, and subsequently to transfer to METC, computer models which will describe the high temperature desulfurization and regeneration processes which occur in fixed-, fluidized-, and moving-bed reactors. Both isothermal models, generally applicable to the desulfurization step, and, when necessary, non-isothermal models are to be prepared. The models are being written in a form as general as possible. However, because of the relatively large amounts of experimental data available for zinc ferrite ($ZnFe_2O_4$) sorbents, this system is being emphasized, particularly during the model validation aspects. Effort to date has concentrated in the background areas of mathematical equation development, investigation of appropriate numerical solution schemes, and appropriate methods of model parameter evaluation. First numerical results for the fixed-bed isothermal model have recently been obtained and are reported here. For the other cases, this report is limited to a discussion of background work which will lead to numerical results in the months ahead. 36 refs., 18 figs., 6 tabs.

20 (DOE/METC—87/6077, pp 141-144) **SO_2/H_2S reactions with calcium-based sorbents.** Cook, J.M. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

A knowledge of the fundamental chemistry of the reactions of sulfur dioxide with sorbents is the overall goal of this project. Specifically, studies are being conducted to determine the kinetics and mechanisms that occur during the initial states of reaction. X-ray photoelectron spectroscopy techniques will be used to obtain experimental data that will provide the means of determining this understanding. This information will be of use in evaluating theoretical models, such as the Pore-Tree Model developed by Gerald Simons of PSI, and will also permit the calculation of rate constant values that can be used in theoretical models as a means of applying them to real world systems. Additional relevant information will be obtained through the use of a packed bed flow reactor which will produce sulfur utilization data based upon the controllable, input parameters, such as initial porosity, internal surface area, temperature, and sulfur dioxide partial pressure. Depth profile studies will be conducted as a means of determining the depth of penetration of sulfur into the sorbent particle and the penetration depth of the oxidation of the sulfur in order to check on the environmental disposability of the resultant ash. Similar type of studies will also be conducted with H_2S as the sulfur gas source as a means of investigating in-bed sulfur capture. Model studies will be used to determine the sorption in the various zones within a fixed-bed gasifier. 3 figures.

21 (DOE/METC—87/6081, pp 4.A1.1-4.A1.16) **Influence of inorganic matter on the flash pyrolysis of some Canadian coals.** Royce, A.J.; Miyawaki, S.; Piskorz, J.; Scott, D.S.; Fouda, S. (Univ. of Waterloo, Ontario). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

In low rank coals much of the inorganic matter is present as cations associated with organic carboxyl groups in the coal rather than as discrete mineral phases. By treating the coal with acid the inorganic content is reduced by cation exchange as well as by acid leaching of discrete minerals. Whole and acid treated samples of pulverized lignite were pyrolyzed in pilot-scale (1-3kg coal/hr) and bench scale (60-100 g coal/hr) fluidized bed reactors at atmospheric pressure, 0.45 second vapor residence time, and temperatures of 550 to 730°C. Yields of char, tar, water, and light gases were determined. Removal of inorganic matter from a Saskatchewan lignite resulted in increased yields of tar and total volatile matter, with little effect on the yields of light gases. Increased yields of tar are largely a result of an increased ashphaltene fraction in general and specifically an increased catechol content. Char from acid washed coal is less reactive to carbon dioxide. 6 references, 7 figures, 3 tables.

22 (DOE/METC—87/6081, pp 5.A1.1-5.A1.14) **Chemcoal process recycle test/Indian Head lignite.** Porter, C.R.; Hetland, M.D.; Knudson, C.L.; Rindt, J.R.; Willson, W.G. (Carbon Resources, Inc., Wheat Ridge, CO). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—). Contract FC21-83FE60181.

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

This report details work at the University of North Dakota Energy Research Center (UNDERC) demonstrating the ChemCoal Process as applied to Indian Head lignite in a full solvent recycle to lined-out, steady-state operation. The ChemCoal Process uses chemical methods to transform coal into clean solid and liquid products. The process features low-severity conversion (temperatures $< 340°C$; pressures < 12.4 MPa (1800 psig)) of coal in a phenolic solvent, with an alkali promoter and carbon monoxide reductant. A successful CPU recycle test to solvent lineout was achieved. Operation was maintained for 39 theoretical passes and was concluded voluntarily. The recycle test was primarily aimed at resolving potential process flaws identified in a 1985 report by Bechtel Group, Inc., ChemCoal Process Evaluation Study. The recycle results showed: ChemCoal Process conversion averaged over 80% of MAF coal and remained relatively constant; no loss in conversion occurred as process-derived solvent replaced start-up solvent in multiple recycles; excess solvent (113%) was generated under all conditions; and reductant consumption was below 2.0 wt% of the MAF coal as hydrogen gas. 6 references, 8 figures, 1 table.

23 (DOE/METC—87/6081, pp 5.A2.1-5.A2.16) **Isotopic constraints on the efficiency of liquefaction of low-ranked coal.** Steer, J.; Muehlenbachs, K.; Ohuchi, T.; Carson, D.; Doherty, B.; Ignasiak, B. (Univ. of Alberta, Edmonton). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The influence of subbituminous Vesta coal upon the processing of stripped Athabasca bitumen (-350°C distillate fraction removed) was investigated in a series of 1-litre stirred autoclave runs in which coal concentration was systematically increased from 0 to 27 wt%. The inherent difference in $^{13}C/^{12}C$ ratio existing between

Vesta coal and stripped bitumen (3.94 parts per thousand) was utilized as a natural isotopic tracer to monitor coal and bitumen incorporation into each synthetic liquid fraction. Comparison of isotopically determined coal-derived product yields indicate that; coal incorporation into distillate, toluene soluble and toluene insoluble fractions progressively increases with increasing coal concentration; and that a change in coal concentration from 15 to 26 wt% results in a three fold increase in toluene insoluble product. Relative incorporation of bitumen-derived carbon into synthetic liquid fractions changes as a function of coal concentration. Comparison of product yields obtained for hydrotreatment of bitumen with those isotopically determined from co-processing runs indicates that, for coal concentrations of 4 to 8 wt% a 14 to 17% increase in distillate yield is observed with a congruent 32 to 49% decrease in toluene soluble yields. Coal concentrations of 15 to 26 wt% result in no appreciable increase in distillate yield over co-processing of bitumen alone, while bitumen derived carbon in the toluene insoluble fraction increases from 0.9 to 5.0%. The results suggest that co-processing of coal-bitumen mixtures comprising of 5 to 10 wt% coal can enhance generation distillate derived from bitumen. 10 references, 2 figures, 9 tables.

24 (DOE/METC—87/6081, pp 6.A1.1-6.A1.10) **Catalytic steam gasification of lignite char.** Kim, J.R.; Kwon, T.W.; Kim, S.D.; Park, W.H. (Korea Advanced Institute of Science and Technology, Seoul). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Reaction kinetics of catalytic steam gasification of Australian lignite chars having mean particle size of 0.3 mm have been studied in a 5.5 cm-ID x 100 cm high thermobalance reactor. The sample char has been prepared by pyrolyzing the lignite at 700°C under atmospheric pressure in a muffle furnace. Three different catalysts (K_2CO_3, Na_2CO_3, Li_2CO_3) and its mixture [(Na, K)$_2CO_3$] were impregnated into the chars in order to determine the effects of catalyst type and amount of catalyst loading (1-5 wt.%) at different reaction temperatures (700-800°C) on the rate of steam gasification. The non-catalytic steam gasification reactions have been well represented by the unreacted shrinking core model in which chemical reaction is the rate controlling step. The reaction orders with respect to carbon were found to be 2/3 in the case of non-catalytic and Li_2CO_3-catalytic reactions. Whereas, the reaction with K_2CO_3 catalyst revealed a zero reaction order. In the cases of Na_2CO_3 and mixed catalytic steam gasification reactions, the reaction rate increased with the reaction temperature and the amount of catalyst loading. Under the same experimental conditions with 3 wt% catalyst loading, the catalytic activities were found to be ranked as Na > mixed > K > Li. Reactivity enhancement factors for the mixed catalysts were found to be the arithmetic mean values of the both Na_2CO_3 and K_2CO_3 catalysts. Activation energies and frequency factors of the catalytic reactions were smaller than those of the comparable non-catalytic steam gasification reactions. 18 references, 7 figures, 2 tables.

25 (DOE/METC—87/6081, pp 6.A2.1-6.A2.14) **Laboratory simulation of postburn UCG contaminant production.** Boysen, J.E.; Mones, C.G.; Glaser, R.R. (Western Research Institute, Laramie, WY). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Contamination of groundwater is a major environmental concern that may delay or prevent commercialization of underground coal gasification (UCG). When UCG recovery operations are terminated, energy is stored in the adjacent masses of rock and coal ash, and this energy is transferred into the coal seam. Coal continues to be pyrolyzed as a result of the energy transferred and the products of this coal pyrolysis are believed to be the major source of groundwater contamination resulting from UCG. A laboratory simulator was developed, and six simulations of UCG postburn coal pyrolysis have been completed. The simulations show that the products of coal pyrolysis are the source of most contaminants associated with UCG operations. Injection of water into the UCG cavity can limit postburn coal pyrolysis and reduce the production of contaminants by cooling the masses of rubble and coal ash in the cavity. However, if the injected water forms channels as it flows through the cavity, the cooling effect is localized and the benefit of the water injection in limiting postburn coal pyrolysis is greatly reduced. Also, water flow through the coal limits postburn pyrolysis and subsequent contaminant generation although steam generated in the hot portions of the coal limits the rate of water flow. UCG field tests should be operated so that the flow of pyrolysis liquids and gases into the formation is prevented, and the natural influx of water into the cavity is allowed. This can be accomplished by minimizing gas leakage to the formation during gasification, venting the cavity when the gasification process is complete, and being sure water injection into the cavity does not cause the steam generated to create too much pressure in the cavity. 7 references, 7 figures, 5 tables.

26 (DOE/METC—87/6081, pp 1.B1.1-1.B1.17) **Gasification island systems.** Bajura, R.A.; Berkshire, L.H.; Craig, K.R.; Klara, J.M.; Stone, K.R. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The technical feasibility of using integrated gasification combined-cycle (IGCC) technology for the production of coal-based electricity is currently being demonstrated at commercial scale (100 MWe) in the Cool Water Coal Gasification Program. METC has explored the performance and economic incentives for advanced gasification/gas turbine power production systems. The term gasification island is used to describe an electric plant using this advanced gasification/gas turbine power production technology. The gasification island itself encompasses all of the processing steps required to convert coal into a clean fuel gas. Gasification island systems use coal gasifiers together with hot gas cleanup processes, either internal or external to the gasifier, to produce a clean, low-Btu fuel gas. The solids handling, gasification, and gas cleanup processes are factory-fabricated modules designed to match the requirements of specific gas turbine systems. By using air-blown gasification systems (which consume less auxiliary power than oxygen-blown systems), hot gas cleanup, innovative tail gas treatment processing schemes, and high-efficiency gas turbine cycles, the thermal efficiency of gasification island systems is projected to be higher than first-generation IGCC systems. Because of standardized designs and simple process configurations, the engineering and equipment costs for gasification island systems are also projected to be significantly lower than first-generation systems. This is particularly true for new capacity additions or life-extension modifications in the 100 MWe size range. This paper describes the results of the gasification island concept systems studies for low-rank coal and reviews the systems implications of the DOE sponsored research programs being conducted in support of the gasification island concept. 13 references, 6 figures, 2 tables.

27 (DOE/METC—87/6081, pp 1.B2.1-1.B2.15) **Conversion of lignite to liquid fuels using Fischer-Tropsch synthesis.** 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

An approach is outlined to the application of the Synthol Synthesis Process as owned and operated by Sasol to using lignite rather than Sasol's young bituminous coal as the raw material. Factors are presented which play a part in shaping an overall plant complex to this purpose. Of the many gasification systems available, three were chosen to illustrate important different parameters of these, i.e., the Lurgi, High-Temperature Winkler and the Shell Gasification Process. The effect of temperature, pressure, formation or otherwise of by-products, nature of the feed and other factors are discussed on raw gas composition, and on the downstream steps of modifying the gas composition by reforming or shift-conversion. The importance of good energy management is explained and stressed. The synthesis plant, its operation, which reactions take place and thoughts on why; the nature of the catalyst, observations on selectivity and reactivity, including loss of activity, and product distribution are discussed. The magnitude of the various factors are illustrated by developing an example, whereby approx. 14 million metric tons of lignite as received (33% moisture - 42% carbon) are converted to 2 million metric tons of liquid fuels, i.e. gasoline,

diesel and LPG. Such a capacity would compare with a 50,000 bbl/day crude oil refinery, but would cost some $50,000 per daily barrel, a number far in excess of that of a conventional refinery. The Sasol operation is financially viable; why, at this stage, it is not in the USA is explained. 9 references, 2 figures, 5 tables.

28 (DOE/METC—87/6081, pp 1.B3.1-1.B3.12) **Dow syngas project - description and status report.** Fisackerly, R.H.; Sundstrom, D.G. (Dow Chemical Co.). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

In the early 1970's, as a result of increasing energy costs and supply uncertainties, Dow recognized the need to establish alternative sources of energy to natural gas. In accomplishing this objective, Dow sought ways to take advantage of the advancements in combustion turbine technology and the US most abundant natural resource, coal. The coal gasification research and development effort that followed included construction of a 36 tpd Pilot Plant in 1979 and a 1600 tpd Proto Plant in 1982. The unique Dow Coal Gasification Process represents the results of Dow's research and development efforts. The 2400 tpd Dow Syngas Project is the first commercial scale demonstration of that technology. This paper describes coal grinding and slurry preparation, gasification and high temperature heat recovery, synthetic gas cleanup and low temperature heat recovery, H_2S removal, sulfur recovery and incineration, combined cycle plant, O_2 plant, and commercial application. 5 figures.

29 (DOE/METC—87/6081, pp 4.C2.1-4.C2.17) **Kellogg's KRW IGCC power generation process.** Van Sickels, M.J. (M.W. Kellogg Co., Houston, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The M.W. Kellogg Company has been developing its KRW pressurized, fluid bed coal gasification/hot gas cleanup technology which, when combined with a combined cycle system, results in an advanced integrated gasification combined cycle (IGCC) power plant. This plant will have superior heat rates, lower costs, and minimal environmental impact. The process has been developed in the KRW pilot plant and has been successfully tested on all types of US coals and lignites. The test work at the KRW pilot plant is a cost shared effort between Kellogg and the US Department of Energy. The first commercial scale demonstration of Kellogg's KRW IGCC process will be in the Kellogg sponsored Appalachian Project. This nominal 60 MW power production facility has been selected by the US DOE to receive financial assistance under its Clean Coal Technology Program. It will be located near the Quemahoning Reservoir in western Pennsylvania. Initial operation is scheduled to begin in 1990. 4 references, 8 figures, 2 tables.

30 (DOE/METC—87/6081, pp PS.24-PS.25) **Kinetic model development for lignite liquefaction.** Moore, P.K.; Anthony, R.G. (Texas A & M Univ., College Station). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The development of an improved kinetic model for coal liquefaction requires the utilization of a more advanced analytical technique than lumped solubility or volatility analyses. Such a technique has been developed using Size-Exclusion Chromatography (SEC), Gas-Liquid Chromatography (GC), and Mass Spectrometry (MS). SEC is used to separate, based on differences in molecular size and compound type, the coal liquid sample into several fractions, which are then analyzed by GC-ms. Thus, the SEC-GC-MS analytical technique provides molecular size, volatility, and mass-spectral information about each coal liquid component. The SEC-GC-MS technique has been used to analyze data from liquefaction experiments performed using tubing bomb microreactors and several lignites. The results of these analyses have been utilized in the development of a general liquefaction model, which incorporates a continuous liquefaction model, which incorporates a continuous lumping scheme. The total combined system, consisting of a tubing-bomb reactor model, a vapor-liquid equilibrium model, the continuously-lumped kinetic model, and a parameter estimation routine, provides a means by which all of the operating parameters in coal liquefaction may be optimized.

31 (DOE/METC—87/6081, pp PS.26) **Colloidal coal cleaning method for low-rank coals.** Olson, E.S.; Diehl, J.W.; Malterer, T.J. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The CCC method converts raw LRCs into a low-ash humate, in a stable aqueous dispersion (latex) which can be acid precipitated. Because LRCs contain abundant carboxylic acid and hydroxyl groups, they are hydrophilic and yield significantly high amounts of humate when treated with aqueous bases. Base treatment and high speed blending are key elements in the method. In the CCC method, coal samples (10 g) were blended with 5% NaOH solution or other basic solution (250 ml) in a 1.25 liter kitchen-style Osterizer under N_2 atmosphere. Temperature rose to about 45°C during blending. Blender speed (high, 24,000 rpm; medium, 18,000 rpm) and time (2 to 12 hrs) were varied in the experiments. The blended slurry was washed into 250 ml centrifuge bottles and centrifuged at 3000 rpm. The supernatant latex (humate) was decanted from the residue. Addition of acid to the latex resulted in precipitation of the humate. Using 5% NaOH, a Beulah (ND) lignite (11.7% mf ash, 2.8% s contents) had highest conversions (90%) at high blender speed and low conversions (28%) at medium speed. The residue (unconverted coal) was examined by photoacoustic FTIR spectroscopy and microscopic petrographic techniques and was found to consist of minerals and liptinite macerals. High conversions of subbituminous coals were also obtained using NaOH and high blender speed. Although bench-scale investigations are preliminary, the results are particularly encouraging, and may suggest that many LRCs may be suitable for this type of cleaning technique. Utilization of the cleaned, precipitated humate can be used directly as an extrudate (pellets, briquettes). Also, preparation of cleaned humate as a slurry is being investigated.

32 (DOE/PC/50041—88) **The Wilsonville Advanced Coal Liquefaction Research and Development Facility, Wilsonville, Alabama: Run 251: Part 1 with Illinois No. 6 coal, Part 2 and 3 with Wyodak coal: Technical progress report.** (Catalytic, Inc., Wilsonville, AL (USA); Southern Co. Services, Inc., Birmingham, AL (USA)). 1987. Contract AC22-82PC50041. 264p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88000060/JAW.

This report presents the operating results for Run 251 at the Advanced Coal Liquefaction R and D Facility in Wilsonville, Alabama. This run operated in the Close Coupled Integrated Two-Stage Liquefaction mode (CC-ITSL) using two different types of coal. Illinois No. 6 bituminous coal was used during the first part of the run designated as Run 251-I. Wyodak subbituminous coal was used during Run 251-II and III. The primary run objective was the demonstration of unit and system operability in the CC-ITSL mode with catalytic-catalytic reactors and with ash recycle. Run 251-I began on 27 April 1986 and continued through 14 June 1986. During this period 232.5 MF tons of Illinois No. 6 coal were fed in 1109 hours of operation. Run 251-II began on 2 July 1986 and continued through 1 September. During this period 172.5 MF tons of Wyodak coal were fed in 1117 hours of operation. Run 251-III began on 21 September and continued through 15 October. During this period 83.6 MF tons of Wyodak coal were fed in 556 hours of operation. Operating conditions were adjusted during the run to obtain high coal conversion, acceptable deashing performance, and an "all-distillate" product slate. Included in Run 251 was: (1) an evaluation of catalytic-catalytic reactors vs thermal-catalytic for both coal types, (2) testing unit and system operability during end-point reduction of distillate solvents from subbituminous coal. 6 refs., 68 figs., 40 tabs.

33 **(DOE/PC/50041—89) The Wilsonville Advanced Coal Liquefaction Research and Development Facility, Wilsonville, Alabama: Development of a simulation model for bituminous coal liquefaction in the integrated process at Wilsonville: Topical report.** (Catalytic, Inc., Wilsonville, AL (USA); Southern Co. Services, Inc., Birmingham, AL (USA)). Aug 1987. Contract AC22-82PC50041. 497p. NTIS, PC A21/MF A01; 1; GPO Dep. Order Number DE88000061/JAW.

The integrated two-stage liquefaction (ITSL) process was a major step in the coal liquefaction technology development. This process consists of a thermal liquefaction unit, a critical solvent deashing unit, and a catalytic hydrotreater in series. The system is integrated by the recycle of hydrotreated resid and solvent to the thermal liquefaction stage. Five ITSL runs were completed at the Advanced Coal Liquefaction R & D facility using Illinois No. 6 bituminous coal and Shell 324 nickel-molybdenum catalyst. This report presents a systematic development of a simulation model to predict the yield structure, stream flow rates, and stream compositions for Illinois No. 6 coal liquefaction in the ITSL configuration. Kinetic models will be presented for first-stage thermal reactions and second-stage hydrotreating reactions using data from a batch autoclave and the pilot plant runs. The applicability of ASPEN (Public) to predict high pressure and high temperature vapor-liquid equilibrium separations in the ITSL process will be shown by comparing the predicted data with the actual plant data. Unit models will be presented for the three units. Finally, these unit models will be integrated into an overall simulation model using ASPEN. 150 refs., 58 figs., 45 tabs.

34 **(DOE/PC/60050—12) Improved coal liquefaction using carbon-supported hydrogenation catalysts: Final technical report for the period October 1983-March 1987.** Scaroni, A.W.; Derbyshire, F.J.; Abotsi, G.M.K.; Solar, J.M. (Pennsylvania State Univ., University Park (USA)). Jun 1987. Contract AC22-83PC60050. 177p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE87012716/JAW.

Various carbons have been prepared (or obtained from commercial sources) and their potential application as catalyst supports investigated, with and without modification to the surface functionality by nitriding and oxidation. Relatively large amounts of nitrogen (3.74%) were introduced into a commercially prepared mesopore carbon (Ambersorb XE-348), which was therefore selected as the principal carbon support. Compared to catalysts prepared upon the original and preoxidized supports (by impregnation with a 90% H_2O/10% EtOH solution of ammonium tetrathiomolybdate), low metal loadings (3% wt Mo) on the nitrided (at 873°K for 1.5 h) support resulted in greatly enhanced hydrogenative activity, as evidenced by the higher asphaltene conversion to oils, with low attendant coke deposition. In the temperature range 648 to 723°K at short reaction times (up to about 2 h) and an initial hydrogen pressure of 6.9 MPa, apparent activation energies of 44.7 and 35.2 kcal mol^{-1}, respectively, were obtained for the noncatalyzed and catalyzed (3% wt Mo on the prenitrided Ambersorb XE-348) conversion of coal asphaltene into oils. The corresponding preexponential factors were 1.3×10^9 s^{-1} and 6.3×10^6 s^{-1}. Since catalytic activity is reported to be influenced by the nature of the metal-containing precursor, catalysts were prepared by the impregnation of different porous carbons with ammonium heptamolybdate and two organometallic precursors: molybdenum-acetylacetonate and molybdenum-tricarbonyltriacetonitrile. The activities of the sulfided catalysts were measured for thiophene hydrodesulfurization in a continuous flow, atmospheric pressure reactor. For a given support and at similar metal loadings, the organometallic precursors conferred much higher HDS activities than the ammonium salt precursors. 150 refs., 41 figs., 32 tabs.

35 **(DOE/PC/70753—T12) The study of some transition metals complexes as process catalysts: Quarterly report for the period June 1, 1987 through August 31, 1987.** Wilson, B.L. (Texas Southern Univ., Houston (USA). Dept. of Chemistry). 1987. Contract FG22-84PC70753. 19p. NTIS, PC A02. Order Number DE88000359/JAW.

The main objectives of this project are the following: Preparation and characterization of transition metal complexes with nitrogen, oxygen, and sulfur donor ligands especially the poly(pyrazolyl)borate ligands; preparation of bimetallic complexes of molybdenum and other metal such as nickel, cobalt, and iron; determination of the ability of the above complexes to catalytically reduce polycyclic aromatic or heterocyclic compounds; evaluation of these complexes as a coal liquefaction catalysts; evaluation of these complexes as desulfurization and denitrogenation catalysts; and training of students in transition metal complex preparation and characterization and in the evaluation of metal complexes as process catalysts.

36 **(DOE/PC/70812—T1) Improved catalysts for coal liquefaction: Quarterly report number 12 for the period June 1, 1987 to August 31, 1987.** Haynes, H.W. Jr.; McCormick, R.L.; Parker, J.W. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 24 Sep 1987. Contract FG22-84PC70812. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000409/JAW.

In a batch reactor screening of silica-supported molybdenum catalysts, it was determined that cobalt and nickel promotion was ineffective and that the silica based catalysts were generally much less active than catalysts prepared on other supports and tested previously. Batch reactor tests were also conducted on a series of nickel molybdate catalysts prepared from titania-alumina composites. The titania-alumina ratio was varied from pure alumina to pure titania. An optimum in activity for specific gravity reduction was observed between the 10 and 55 mole percent titania composition, and this roughly corresponded to a maximum in pore volume in the 60 to 200 A diameter range. A new feedstock was prepared by spiking a mildly hydrogenated creosote oil (HCO-1) with 20% residuum material from Wilsonville Run 247. A 450 hour deactivation run with the new feedstock and Amocat 1A indicated that the addition of residuum to the distillate feedstock did not result in a more rapid deactivation. A process variable study was conducted at the end of the deactivation run and kinetics models were developed for specific gravity reduction, hydrogen uptake and hydrodenitrogenation. 9 refs., 11 figs., 9 tabs.

37 **(DOE/PC/90508—T3) Continuous thermodynamics and group contribution methods for coal liquids: Annual report, October 1, 1986-October 1, 1987.** Allen, D.T.; Behmanesh, N. (California Univ., Los Angeles (USA). Dept. of Chemical Engineering). 1987. Contract FG22-86PC90508. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88000366/JAW.

Property estimation methods for complex mixtures rely on chemical characterizations of the mixtures. Structural characterization is in turn, based on the information that can be obtained from analytical techniques. The goal of this work is to develop a method for interfacing analytical data with property estimation methods. The case study to be used in this work is the estimation of thermodynamic properties of coal derived liquids. Structural profiles of narrow-boiling range fractions from three coal liquefaction processes were determined by identifying the major functional groups in the distillates and estimating their concentrations. The structural profiles were based on an extensive set of analytical data including results from elemental analysis, proton nuclear magnetic resonance, mass spectrometry, infrared spectroscopy and liquid chromatography. The calculated group concentrations were then used in a group contribution approach for predicting the liquid phase heat capacities of the narrow-boiling distillates. The heat capacities were also predicted using two other procedures, corresponding states and curve fitting methods. In the last part of this work a method was developed and demonstrated to assess the information value of the sources of analytical data in performing the heat capacity estimation for the coal derived liquids. Liquid heat capacities of the narrow-boiling distillates were determined using data subsets from the extensive set of analytical data. The predicted values and the determined uncertainty ranges showed that a combination of ^1H NMR data and carbon to hydrogen ratio yielded the best ratio of precision to measurement cost for the samples that were used in this work. 36 refs., 6 figs., 28 tabs.

38 **(DOE/PC/90538—4) Use of basic nitrogen to chemically clean coal: Annual report for the period September 1986 to September 1987.** Silver, H.F. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 30 Sep 1987. Contract FG22-86PC90538. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000392/JAW.

During the initial phase of this study, the effect of reaction variables on the desulfurization and liquefaction of a North Dakota lignite, a Wyoming subbituminous coal and a Kentucky bituminous coal was established. Four different sterically hindered, basic nitrogen compounds were then introduced to the reacting mixture with the coal derived distillate solvent and a series of reactor runs were repeated. The results of these experiments have been analyzed statistically to determine which, if any, of the nitrogen bases had the greatest effect in promoting desulfurization and liquefaction. Although some beneficial effects could be attributed to nitrogen bases, none of the bases added removed more than 40 wt% of the sulfur from any of the coals studied and conversions to pyridine soluble liquids were below 60 wt%. This has been attributed to the relatively small quantity of nitrogen bases added to the coal liquefaction distillate solvents produced from similar coals in SRC processes. Further work will be directed toward determining the effect of nitrogen base concentrations. 7 tabs.

39 **(EPRI-AP—5453) Liquefaction coprocessing: A study of critical variables: Final report.** Miller, R.L. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 103p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920046/JAW.

Results are reported for a series of experimental liquefaction co-processing runs using two subbituminous coals, two agglomerated, partially deashed subbituminous coals, and seven heavy oil samples. Variables studied in this research included: reaction severity, heavy oil prehydrotreatment, feed coal reactivity, heavy oil reactivity, feed gas composition, and use of a disposable coal dissolution catalyst. Over 88 wt % distillate yield (MAF coal basis) was achieved by co-processing Wyodak subbituminous coal and Colorado shale oil at low severity reaction conditions using CO feed gas and iron sulfate catalyst. This result was partially attributed to the beneficial effect of heterocyclic basic nitrogen compounds abundantly present in the shale oil. Experimental design studies demonstrated that feed coal reactivity, heavy oil reactivity, and reaction severity all affect liquefaction co-processing performance. Use of a disposable coal dissolution catalyst can partially offset the negative effect of low feed coal reactivity. 48 refs., 18 figs., 20 tabs.

40 (EUR—10070-DE-EN-FR, pp 1-11) **Morphologic development of semicoke from carbonization under hydrogen pressure.** Cypres, R.; Laudet, A.; Laurent, P.; Braekman-Danheux, C. (Universite Libre de Bruxelles, Belgium. Service de Chimie Generale et Carbochimie). 1985. (In French). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8412110—1).

From Round table meeting on chemical and physical valorization of coal; Brussels, Belgium (7 Dec 1984).

Technical coal research.

Optical microscopy was applied for investigating the morphological evolution of semicoke obtained by pyrolyzing a subbituminous Beringen coal between 400 and 800/sup 0/C at a pressure of 3 MPa of helium and hydrogen. The main change observed after pyrolysis below 500/sup 0/C was the total disappearance of exinite, which is particularly rich in volatile matter and accounts for nearly 8% by volume of the analyzed coal. The disappearance is independent of the type of reaction gas used. The reflectometric measurements showed that the devolatilisation of vitrinite starts in this temperature range. The development of the reflectivity of vitrinite as a function of the pyrolysis temperature is identical in the presence of both gases, at least at temperatures below 460/sup 0/C. On the other hand, the texture of the semicokes differed according to the reaction atmosphere, with vitrinite becoming more rapidly isotropic in a H/sub 2/ atmosphere. At higher temperatures, i.e. between 500 and 800/sup 0/C, a granular anisotropic phase with a fine mosaic structure is developed in the semicoke, especially at elevated pyrolysis temperatures and in a H/sub 2/ atmosphere.

41 (EUR—10070-DE-EN-FR, pp 57-77) **Laboratory investigation of the catalytic hydroliquefaction of coal.** Pregermain, S. (Centre d'Etudes et Recherches des Charbonnages de France, CERCHAR, 60 - Verneuil-en-Halatte). 1985. (In French). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8412110—1).

From Round table meeting on chemical and physical valorization of coal; Brussels, Belgium (7 Dec 1984).

Technical coal research.

Discontinuous autoclave experiments were carried out on different ferrous materials envisaged as catalysts for hydrogenating liquefaction of Lorraine coals, i.e. two 'burner oxides' obtained by decomposition in a flame of a volatile precursor and hydroxydes obtained by precipitation from iron salt solutions. Both products can be converted into high-activity catalysts after sulphurisation by adding carbon sulphide to the reaction mixture. Encouraging results were obtained for both groups of products, but there are still problems concerning reproducibility and storage. The catalysts were characterized by determining their specific surface as well as by electron microscopy, X-ray diffraction, and Moessbauer spectroscopy.

42 (EUR—10070-DE-EN-FR, pp 129-141) **Microscopic analyses of coals of different origin.** Steller, M. (Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen, Germany, F.R.). 1985. (In German). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8412110—1).

From Round table meeting on chemical and physical valorization of coal; Brussels, Belgium (7 Dec 1984).

Technical coal research.

Coals of different origin and with different composition were hydrogenated under identical conditions, in order to define their different hydrogenation characteristics and the differences in the composition of the hydrogenation residues. Three coal grades from the USA Western Kentucky No. 9, Western Kentucky No. 14 and Illinois II), 2 coal grades from Brazil, and 2 Ruhr coal grades were hydrogenated in identical conditions (temperature = 450/sup 0/C, time of residue = 2 h, pressure = 300 bar). The feed coals and hydrogenation residues were characterized by means of coal petrography.

43 **(PB—87-215729/XAB) X-ray-absorption spectroscopic study of the reactions, dispersion, and degradation of the Ca and K catalytic species in coal gasification. Annual report, January-December 1986.** Huggins, F.E.; Shah, N.; Huffman, G.P.; Jenkins, R.G. (MacroAtom, Inc., Monroeville, PA (USA)). May 1987. 52p. NTIS, PC A04/MF A01.

See also report for Jan-Dec 85, PB—86-201050.

EXAFS spectroscopy, supplemented by other techniques, is being used to investigate the behavior and reaction of alkali and alkaline earth catalysts in various chars derived from lignite and other carbonaceous materials. Recently, in-situ EXAFS techniques were successfully developed and demonstrated for Ca and K in lignites and chars under pyrolysis and gasification conditions to 600 C. The in-situ EXAFS investigation revealed only minor changes the state of Ca in chars under pyrolysis and O_2 gasification to 500 C. For K-loaded chars, however, similar minor changes were observed during pyrolysis but K_2CO_3 was formed under O_2 gasification. In addition, a reexamination of Ca in freshly prepared rapidly and slowly prepared chars was undertaken. In contrast to earlier work on aged chars, EXAFS revealed that slowly pyrolyzed chars do contain significant CaO; however, Ca in rapidly pyrolyzed chars remains highly disordered as no evidence for CaO or other phase was found. The authors attribe the lack of CaO in the aged chars to hydrolysis and reaction of CaO to $Ca(OH)_2$ and $CaCO_3$. Both ambient and in-situ EXAFS examinations of Rb-loaded materials are as yet somewhat inconclusive because of experimental problems and the similarities exhibited in spectra of key compounds.

44 **(PB—87-225926/XAB) Fundamentals of coal-char chemistry. Annual report, February 15, 1986-February 14, 1987.** Stein, S.E. (West Virginia Univ., Morgantown (USA)). Mar 1987. 132p. NTIS, PC A07/MF A01.

See also PB—86-215696.

Experimental and theoretical studies aimed at clarifying the underlying organic chemistry of coal gasification were carried out. Experimental studies led to the formulation of a detailed mechanism for forming condensed ring compounds. The competitive processes of dissociation, isomerization, and ring hydrogenation were also analyzed. In other studies, a number of features of bond formation by aryl radicals were elucidated. Trends in reactivity are quite different than previously found low temperatures. A theoretical analysis of the pi- and sigma-electronic properties of large polycyclic aromatic compounds was completed. Although pi-electron properties are generally viewed as being highly delocalized, the studies showed that the local structures largely determine reactivity. Properties of localized free-radical centers are even more dependent on more local factors, although important influences of the neighboring atoms were identified and three subgroups of aryl radicals were distinguished.

45 **Solubilization of coal by chemical process.** Strandberg, G.W.; Lewis, S.N. (to Dept. of Energy). US Patent Application 6-925,600. 31 Oct 1986. 11p. Contract AC05-84OR21400. DE88000840 NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000840/JAW.

The invention involves exposing coal to an oxidizing agent such as nitric acid, hydrogen peroxide, or ozone. It is preferable to maximize the surface area of the coal to accelerate oxidation; therefore, coal is broken and crushed into small pieces. The coal is then placed in an oxidizing solution for a sufficient period of time to render it susceptible to solubilization. Exposure to oxidizing agent at 30°C for about two days gives good results, although these parameters are not critical. After oxidation, the treated coal is placed in a base solution. Since the original studies were aimed at determining if certain microorganisms could solubilize coal after oxidation pretreatment, the base solutions used for study were organic buffer solutions ordinarily used in biological studies. Although most tests were done with such bases, it was found that a simple sodium hydroxide solution was also very effective, and therefore, it is believed that the critical factor is pH and not the identity of the base; thus, any base would be suitable for use in this solubilization process. The coal can be washed prior to exposure to the base to remove oxidizing agent that might tend to lower the pH of the solubilizing solution. Shaking the coal and base solution can enhance the solubilization process, although it isn't necessary. After two days exposure under ambient conditions, coal is significantly solubilized and can be separated from the solute by centrifugation and filtration.

0105 By-products

REFER ALSO TO CITATION(S) 240, 248

46 **(AD-A—182929/0/XAB) Combustion by-products on F-4 drogue parachutes. Final report.** Poitrast, B.J.; Keller, W.C.; Elves, R.G. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Jun 1987. 8p. (USAFOEHL—87-073C00253FOC). NTIS, PC A02/MF A01.

Concerns of F-4 drogue parachute packers concerning cracking and peeling dry skin led to analysis of the parachutes for polynuclear aromatic hydrocarbons (PAH). F-4 drogue parachutes with varying numbers of deployments were analyzed for PAH. Results show a linear increase of PAH concentration with increasing deployments. Protective measures are suggested.

47 (DOE/METC—87/6081, pp 2.A1.1-2.A1.16) **Use of lignite coke for reduction of NOx after flue gas desulfurization.** Marnet, C.; Kassebohm, B.; Asmuth, P. (Stadtwerke Duesseldorf AG, West Germany). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

An optimal solution for NOx reduction seems to be the combination of a lignite coke filter and catalyst. This type of a multistage filter coupled with the spray drying system, filters the rest of solids, adsorbs (the rest of) the acidic components, the vaporous heavy metals, the carbon hydrates, etc. After adding ammonia to the flue gas the coke coal then works as a catalyst for the NOx-reduction at temperatures of about 80 to 100°C. The lignite coke is an uncomplicated, unexpensive material, which is burned as fuel after use. The coke consumption only depends on the amount of the acidic components in the flue gas (i.e. efficiency of the scrubber). The results measured up to now have shown that with lignite coke. (1) the flue gas from a coal fired boiler can be completely desulfurized, whereby SO_2 loadings of the coke of 10-15% are to be achieved, (2) in a flue gas remaining for a period of 15-20 seconds it is possible to achieve NOx reductions of 80-90%, and (3) the NOx content in the clean gas varies between 150 and 250 mg/m^3n. 12 figures.

48 (DOE/METC—87/6081, pp 3.C1.1-3.C1.16) **Development of new uses for Victorian brown coal.** Perry, G.J.; Royston, D.; Allardice, D.J. (Coal Corp. of Victoria, Australia). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The extensive low rank coal deposits in Victoria, Australia, were in 1982 estimated at 197,000 million tons (Mt) of which 43,000 Mt are readily recoverable reserves using present day open cut mining technology. The need to coordinate the orderly development of the brown coal deposits coupled with high commercial interest shown in the brown coal led to the formation by the government in 1985, of a new statutory corporation, the Coal Corporation of Victoria, to lead the commercial development of brown coal for uses other than power generation. Initially 5 Mtp of high purity Loy Yang coal have been made available for commercial development. Research and development activities have centered around the natural attributes and unique properties of the coal for a variety of new uses. The high oxygen content (25% dmif) can be turned to advantage by the development of ion exchange materials for metal extraction in environmental and industrial applications. By carbonization and steam activation activated carbons with high surface areas can be produced. The high moisture holding capacity of the coal together with its open friable structure and humic acid content make the coal potentially suitable for horticultural and agricultural applications as a soil conditioner. Research and development of these new products together with many other areas of applied and fundamental research are being conducted in Victoria by Government research organizations, tertiary institutions and private industry. 20 references, 1 figure, 5 tables.

0106 Properties

REFER ALSO TO CITATION(S) 30, 37, 161, 168, 264, 422, 423, 424

49 (DOE/METC—87/6077, pp 91-97) **Rheological and heat transfer characteristics of flowing CWM.** Novack, M.; Tsai, C.Y. (General Applies Science Labs., Inc., Ronkonkoma, NY). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23255.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objectives of this research program is the development of a consistent data base and the derivation of engineering correlations for the prediction of pressure gradients and heat transfer coefficients in pressurized, heated flows of CWM. The range of heating conditions over which the data and correlations are to be acquired extends from simple convection heat transfer with laminar flow, through subcooled boiling, to nucleate boiling of turbulent suspensions of coal particles in water. The design, fabrication, and calibration with water of the experimental have been completed and are discussed. 2 references, 3 figures.

50 (DOE/METC—87/6077, pp 119-122) **Laser-induced breakdown spectroscopy (LIBS) for the analysis of combustor/gasifier streams.** Chisholm, W.P. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The primary objective of this research is to develop a routine, real-time, in situ analysis system based on laser-induced breakdown spectroscopy (LIBS), applicable to the analysis of high-temperature, high-pressure process streams. The tasks constituting the LIBS portion of this project are (1) the identification and characterization of the parameters that affect detected atomic emission intensity, (2) the development of a data acquisition and reduction system, (3) the testing of prototype apparatus on a process stream, and (4) the automation of the apparatus with simplification of the detection system. Results of current investigations have focused on determining the time dependence of atomic and ionic line emissions from iron- and sodium-containing aerosols in an inert carrier. In addition, Stark broadening and shifting parameters of emission lines of analytical interest have been assessed. Development of a wavelength calibration system has also been completed. 4 figures.

51 (DOE/METC—87/6077, pp 182-189) **Fiber optic instrumentation development.** Hensel, J.P. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

Specific areas that have been addressed under this project include: the study of non-isothermal radiometry, the development of high temperature fiber optics, and the development and application of an improved technique for monitoring emission lines in fossil energy (FE) processes. The goal of the non-isothermal radiometry study is to identify, through computer simulation, pyrometric techniques capable of isolating desired temperatures from complex non-isothermal targets such as those encountered in fossil-fueled processes. Work in the high temperature fiber optics area is aimed at providing improved optical access to FE processes through the development of sapphire optical fiber. Sapphire, as opposed to the commonly used quartz, provides optical access to wavelengths beyond the near infrared (to approximately 6 microns) and is capable of withstanding temperatures up 3400 F. Thus, probes composed of sapphire fibers would allow optical access to areas that are impossible to reach with straight rod-type probes, would not require cooling, and could be used to monitor the emission/absorption lines of CO, CO_2 and CH_4. Finally, a technique for enhancing the observation of emission lines in a FE environment has been developed. This technique, known as BLOC (Blackbody Observation and Cancellation) is capable of reducing the effect of blackbody radiation occurring at the wavelengths of the desired emission lines (due to hot walls and/or hot particles in the field-of-view of the monitoring instrument), by 20 dB or more. This technique has been utilized in the design of two instruments at METC - a sodium D-line sensor used to detect flameouts in fossil-fueled processes, and a highly sensitive alkali monitor used to measure the solid and vapor-phase alkali content of FE process streams. Both of these instruments have been successfully tested on METC's Coal-Water Mixture (CWM) combustor. 11 figures.

52 (DOE/METC—87/6077, pp 246-255) **Optical detection of corrosive compounds.** Oldenborg, R.C.; Baughcum, S.L. (Los Alamos National Lab., NM). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

An attractive option for the future generation of electrical power is to drive gas turbines with fuels derived from the economically priced and domestically prevalent resource coal. However, turbine components are susceptible to corrosion and deposition from even trace amounts of certain inorganic contaminants, particularly the alkali metals and their compounds. The objective of this program is to develop a laser-based optical diagnostic technique for the direct monitoring of trace levels of corrosive compounds, in particular gas-phase alkali compounds, within the post-combustion coal gas stream. The diagnostic needs to be compounds specific and sensitive to parts per billion (ppb) levels. The diagnostic currently under development is based on the photofragment fluorescence technique, in which atomic alkali emissions is detected upon ultraviolet photodissociation of alkali-containing compounds. Experiments to evaluate the photofragment fluorescence technique for NaCl, KCl, and NaOH in terms of discrimination potential, sensitivity, and quantitative behavior have been completed. All results so far look very promising for potential applications in post-combustion coal gas streams. Results are discussed. 7 references, 4 figures, 1 table.

53 (DOE/METC—87/6077, pp 256-282) **Characterization of alkalis in the exhaust gas from pressurized combustion of a coal-water mixture.** French, W.E.; Logan, R.G. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of alkali characterization studies is to determine the effects of the combustion of a coal-water mixture on the concentrations and distributions of gaseous and particle-bound sodium and potassium concentrations in a combustor exhaust. Specific goals of this investigation are to develop an on-line method of measuring gaseous and total alkali concentrations at gas turbine inlet temperatures, to verify the performance of this method, and to utilize it to determine the effects of combustor operating parameters on solid and gaseous alkali concentrations in the combustor exhaust. During these tests, low ash coal-water mixtures (CWM) and natural gas were separately fired in a 12-inch diameter, 4-foot long, bench-scale pressurized combustor. High-temperature, high-pressure alkali sampling systems were used to deliver slipstreams of the exhaust gas to two on-line alkali monitors operated in parallel. One of the monitors measured the level of gaseous alkali in the exhaust, the other measured total alkali (gaseous and particle bound). The alkali sampling systems were designed to maintain slipstreams of the combustor exhaust gas at conditions which were representative of those at the inlet of a gas turbine. Statistical analyses of data collected to date show that correlations may exist between the temperature of the exhaust gas and the concentration and phase distribution of alkalis in the combustor exhaust. Analyses of the sampling system indicate that careful control of the sample line temperature is necessary for representative measurements; however, the measurements are relatively insensitive to the materials of construction at temperatures above 1200 F. 36 references, 8 figures, 9 tables.

54 (DOE/METC—87/6077, pp 291-297) **Alkali species characterization for coal-fueled gas turbines.** Spiro, C.L. (General Electric Co., Schenectady, NY). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-85MC22164.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of this contract is to characterize the chemical transformations of alkali metal species during combustion and deposition of coal in gas turbine environments. A second objective is to relate the chemical behavior of coal ash to deposition rates. To explore these issues, scaled combustion/deposition tests have been performed in environments representative of real gas turbines. Deposit and particulate materials captured from the products of combustion are undergoing extensive physical and chemical analyses. Coal-water-mixture fuels and ashes were studied by a battery of analytical methods including electron microscopy (SEM and STEM), x-ray analysis (XRD, EDAX), wet chemical methods, size distribution analysis, low-temperature ashing, and x-ray absorption fine structure and x-ray absorption near edge spectroscopy (EXAFS, XANES). EXAFS spectroscopy has been an important tool in identifying the forms of coal ash species, and has been applied to the study of potassium transformation chemistry since alkali plays a major role in corrosion and deposition in gas turbines. Results are discussed. 9 references.

55 (DOE/METC—87/6077, pp 378-397) **Effects of particle size on the compression ignition of dry coal.** Ayers, W.J. Jr.; Nakaishi, C.V.; Wojewodka, R.A. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The effects of coal particle size on ignition characteristics of burnout rates were investigated using a combustion bomb designed to simulate ignition conditions of a compression ignition engine

(diesel). The test fuels included lignite, subbituminous, and bituminous coals in particle size ranges of 0-37, 37-74, and 74-125 microns. Diesel fuel was also used as a control in the study. The bulk gas properties used to simulate ignition conditions were 700 K at gas densities of 15.7 kg/m³ and 29.5 kg/m³ and 800 K at a gas density of 29.5 kg/m³. Results from the study indicated that pressure recovery delay exhibited a strong relationship between fuel type, coal particle size, bulk gas temperature, and gas density. The results also showed that heat release rates were significantly affected by coal particle size, bulk gas temperature, and gas density. The variables mentioned above also had significant effects on start of ignition and duration of pressure rise during fuel combustion as measured by pressure traces, luminosity ignition delay, and duration of combustion luminosity as measured by high-speed videos of the combustion events. This paper presents a detailed discussion of the combustion bomb design, its ancillary components, and the test results. 5 references, 13 figures, 4 tables.

56 (DOE/METC—87/6081, pp 1.A3.1-1.A3.18) **Physical-chemical composition of lignite coal ash: a review.** Murarka, I.P.; Guertin, J.P. (Electric Power Research Institute, Palo Alto, CA). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The combustion of Texas and North Dakota lignite coal results in an ash consisting of essentially inorganic glassy, spherical particles. (The organic content is $<<0.1\%$.) Physical properties, species solubility, and elemental and mineral composition are documented. The ash contains numerous minerals, quartz being the dominant mineral. The flue ash particles are 5 to 100 μm in diameter, relatively richer in gallium, lead, selenium, and zinc compared to the 100 to 10,000 μm bottom ash particles. The solubility of inorganic constituents in the lignite ashes is a measure of the leaching potential. The extractor species greatly influences the elemental concentrations in the extracts. For example, ash elemental concentrations in nitric acid extracts are typically a few orders of magnitude higher than in hot water extracts. Sulfate and calcium are the most abundant species observed in hot water and nitric acid extracts, respectively. A comparison of the toxicity characteristic leaching procedure versus the existing extraction procedure shows notable differences only for iron extract concentrations. 9 references, 4 figures, 7 tables.

57 (DOE/METC—87/6081, pp 5.A3.1-5.A3.15) **Study of variability in the distribution of chemical species in coal conversion products using size exclusion chromatography - gas chromatography - mass spectrometry (SEC-GC-MS).** Philip, C.V.; Anthony, R.G. (Texas A & M Univ., College Station). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The low rank coals used in the liquefaction experiments were Texas Big Brown lignite from the Wilcox formation, Zap-2 Indian Heat lignite and Beula lignite from North Dakota and Wyodak coal from Wyoming. The samples of liquid products were used for the detailed analysis. The SEC-GC-MS analysis data on low rank coal derived liquids which were produced under varying liquefaction conditions were used to identify probably chemical reactions responsible for converting coal to liquid products. A striking similarly was observed in the identity of chemical species in anthracene oil, recycle solvents and the low rank coal derived liquids. The aromatic species which are characteristic of coking oven products from coal, such as anthracene oil and creosote oil were found in all low rank coal derived liquids from the liquefaction experiments, including the one using water under super critical conditions. However there were variations in the concentrations. The hydroxy aromatics, also known as alkylated phenols, which are produced under lignite liquefaction experiments, are not major components in anthracene oil. The straight chain hydrocarbons, mainly alkanes which are found in any coal liquid and are observed as sharp peaks are substituted with a hump of GC. It appears that the pyrolytic conditions used in coking oven are destroying or converting most of the straight-chain alkane species and producing numerous isomeric hydrocarbons as evidenced by the MS fragmentation patterns of the GC hump. The paper presents analysis data on specific samples to demonstrate the basic trends in liquefaction reactions as well as the instrumentation and analysis techniques. 15 references, 5 figures.

58 (DOE/METC—87/6081, pp 2.B1.1-2.B1.16) **Monitoring programs for unit operational problems due to highly fluctuating lignite quality.** Andrew, D.; Darmstaedter, E.; Vidovich, J. (GUS, Inc., Dallas, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Mine mouth power generating stations burning Texas lignite can experience operational problems due to periods of widely fluctuating lignite quality. Intermittent problems can occur in the areas of dust generation, lignite handling system pluggage, slagging, and flyash collection. Lignite quality changes affecting operations in these areas can be grouped into primary and secondary categories. Field quality monitoring equipment is available that can measure these quality changes, usually in less than one hour. Monitoring equipment results can then be correlated with existing operations information. General lignite quality range limits can be identified which predict the onset of operational problems. With the additional capabilities of programmable logic controllers and PC data acquisition systems, diagnostic and long term monitoring programs can be run effectively. 5 references, 11 figures.

59 (DOE/METC—87/6081, pp 7.C2.1-7.C2.2) **Characterization and classification of lignite fly ashes for use in concrete.** Manz, O.E.; Dockter, B.; McCarthy, G.J.; Johansen, D.M. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

There have been various studies to improve the reliability of predicting the performance of lignite fly ash in concrete, based on the pozzolanic activity index. Mineralogically, x-ray diffraction is a valuable tool to explain the behavior of lignite fly ashes in concrete, with respect to strength and sulfate resistance. There are several specifications involving the use of fly ash as a partial replacement for portland cement in concrete. The controversy between Class F (bituminous and anthracite) and Class C (lignite and subbituminous) fly ashes has been due in part to the wide variation of chemical, physical, and mineralogical properties of the lignite fly ashes. Many lignite fly ashes can meet the specification limits for Class F fly ash. A summary is presented of various investigations involving lignite fly ashes in concrete and mortars, and an attempt is made to characterize and classify the North American lignite fly ashes, using mineralogical, chemical, and physical data. The geological variability of the lignite formations, as well as the varying power plant configurations are addressed.

60 (DOE/METC—87/6081, pp PS.5) **Measurement and modeling of thermal properties of lignite coals.** Glatzmaier, G.C.; Ramirez, W.F. (Univ. of Colorado, Boulder). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The thermal conductivity and thermal diffusivity of solid and powdered lignite coals were measured as a function of temperature and pressure using the transient hot wire method. The mathematical basis for the use of this method for measurement on solid materials is well understood and documented. Thermal property measurements on two-phase materials (powders) are more complex to analyze than those of solid materials. Heat transfer mechanism in powders include conduction through the solid phase, conduction through the gas phase, along with heat transfer between the phases at any point in the material. Because of this complex means of heat transfer, thermal properties of powders are not true properties but are effective properties which account for all the heat transfer mechanisms. A mathematical model based on volume averaging was developed to predict measured values of the effective thermal properties of powdered materials. Modeling of the thermal properties included several powdered samples other than coal including glass beads and powdered oil shales. The model accurately predict-

ed thermal properties of these samples which varied as a function of pressure over several orders of magnitude. This work provides an understanding of thermal property measurements of powders and of heat transfer mechanisms in general.

61 **(DOE/PC/90507—T4) Surface properties of coal and their role in coal beneficiation: Technical progress report, 16 June to 15 September 1987.** Fuerstenau, D.W. (California Univ., Berkeley (USA). Coll. of Engineering). Oct 1987. Contract FG22-86PC90507. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000723/JAW.

Our previous report focused on investigation of how the wetting behavior of various bituminous coals changes upon oxidation for various periods of time and degree of thermal treatment. Changes in coal wetting behavior were assessed by determining the mean critical wetting surface tension of the coals before and after oxidation, using the film flotation technique developed in our laboratories. In order to have a more realistic picture of coal surface changes upon oxidation, research work this past quarter involved FTir spectroscopy studies on both as-received and oxidized coals. Infrared (IR) spectroscopy is a useful tool to identify the chromophoric forms in coal. More importantly, the functionality of oxygen on the coal surface can be identified and distinguished from oxygen contained in the mineral component. This report presents the results of the IR spectra Pittsburgh coal as a representative of the 18 coals tested. The spectra of Kittanning and Springfield coals are also given as examples of high-ash coals. Finally, the results of the oxidation studies on Cambria No. 78 coal are discussed. To further characterize the surface of bituminous coals subjected to various degrees of thermal oxidation, during the past quarter we also determined the acidic oxygen functional groups concentration on both as-received and oxidized coals by using an aqueous potentiometric titration method. The oxygen content of these functional groups was then correlated with oxidation temperature, time, the mean critical wetting surface tension, and total oxygen content of coals. Details of the experimental procedures and results, and the discussion of our findings are given. 10 refs., 5 figs., 2 tabs.

62 **(DOE/PC/90911—6) Pyrolysis GC/MS analysis of low-rank coal.** Miller, D.J.; Hawthorne, S.B. (North Dakota Univ., Grand Forks (USA). Energy Research Center). 1987. Contract FG22-86PC90911. 8p. (CONF-870802—19). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000308/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

The reactivity of coals under liquefaction conditions is related to their thermal decomposition. Pyrolysis GC/MS is used to determine the identity of the volatile products as the changes in coal structure occur. A Wyoming subbituminous coal (Clovis Point) and a North Dakota lignite (Indian Head) were heated under helium at four temperatures (160°C, 250°C, 300°C, and 350°C) for 30 minutes. The volatile species were cryogenically trapped in a capillary gas chromatographic column for GC/MS analysis. The two lower temperatures showed only devolatilization products (e.g., biological markers such as alkanes and terpenoids) while the higher temperatures yielded products resulting from bond-breaking (i.e., pyrolysis). The devolatilization and pyrolysis products of the two coals were similar in overall composition but markedly different in their distribution. The subbituminous coal (Clovis Point) pyrolysate contained phenol and cresols along with large amounts of C_{19} to C_{31} normal alkanes. Indian Head lignite pyrolysate contained a much larger amount of phenol, alkyl substituted phenols and dihydroxybenzene and lesser amounts of C_{19} to C_{31} alkanes. 10 refs., 3 figs.

63 **(DOE/PC/90913—T3) Biochemical bond breaking in coal: Fourth quarterly report, [July 1, 1987 through September 30, 1987].** (Atlantic Research Corp., Alexandria, VA (USA)). Oct 1987. Contract FG22-86PC90913. 14p. (ARC—49-5226). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000726/JAW.

Initial model compound studies indicated that whole cultures and culture supernatants of CP1+2 were potentially capable of cleaving a variety of bonds. All of the model compounds tested were biotransformed by CP1+2 except for benzoic acid. However, more recent studies with the model compounds have shown that benzoic acid can also be biotransformed by CP1+2 if adequate mixing and air are provided. In a recent study, whole cultures of CP1+2 reduced the concentration of benzoic acid by 80%, and culture supernatants reduced the concentration by 30%. Thus, either ring cleavage or decarboxylation may have occurred with benzoic acid and with some of the other model compounds tested. Identification of the model compound degradates is necessary to confirm that cleavage of the interunit linkages occurs. Some of the degradation products resulting from studies using model compounds containing ester linkages have been identified. Butyric acid was detected following addition of ethyl butyrate to CP1+2 cultures, and resorcinol was detected following addition of resorcinol monobenzoate. A postulated mechanism for ester cleavage in these compounds involving a hydrolases enzyme is shown in Figure 6. An enzyme assay will be used to verify the presence of ethanol following ethyl butyrate degradation by CP1+2. Further studies are necessary to determine the products of benzoic acid degradation. 5 figs., 2 tabs.

64 (EUR—10070-DE-EN-FR, pp 79-90) **Recent findings of solid state NMR spectroscopy in coal and coal products.** Gerhards, R.; Kasueschke, I. (Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen, Germany, F.R.). 1985. (In German). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8412110—1).

From Round table meeting on chemical and physical valorization of coal; Brussels, Belgium (7 Dec 1984).

Technical coal research.

There are few analytical processes for characterizing chemical structural elements in coal and solid coal products in the solid phase. On the other hand, transfer into the dissolved state normally is either not completely possible or will lead to a modification of the chemical structure. One of the applicable methods is /sup 13/C-NMR solid state spectroscopy. Initial findings of the process are reported.

65 (EUR—10070-DE-EN-FR, pp 91-128) **Micropetrographic analyses of residues from hydrogenating liquefaction of brown coal.** Hagemann, H.; Wolfrum, E. (Technische Hochschule Aachen, Germany, F.R.; Rheinische Braunkohlenwerke A.G., Koeln, Germany, F.R.). 1985. (In German). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8412110—1).

From Round table meeting on chemical and physical valorization of coal; Brussels, Belgium (7 Dec 1984).

Technical coal research.

Micropetrographic analyses of residues from hydrogenating liquefaction of brown coal provide information on the yield of liquid or gaseous products from the changes in the feed coal macerals. Up to the plastic phase of the coal components, this is possible by means of reflection measurements on the macerals ulminite B and gelinite. The reflectivity increases with the reaction temperature and, to a lesser extent, with the reaction time. The micropetrographic composition of the hydrogenation residues changes in the same manner as the reaction temperature increases. Pressure, time, and different catalyst contacts also have some influence on the modification or new formation of components. The micropetrographic analyses show that pressures of 250 to 300 bar, reaction times longer than 30 minutes, and reaction temperatures around 440/sup 0/C are favourable for hydrogenating gasification of soft lignite in autoclave experiments.

66 (EUR—10070-DE-EN-FR, pp 159-179) **Development of binder coke structure in baked anodes.** Sharp, J.A. (Tar Industries Services, Chesterfield, UK). 1985. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8412110—1).

From Round table meeting on chemical and physical valorization of coal; Brussels, Belgium (7 Dec 1984).

Technical coal research.

The development of the microscopic structure of the binder carbon in baked laboratory test anodes has been followed by micro-

scopic examination of small test cylinders produced from a narrow size-graded petroleum coke bound with different pitches. These cylinders were heat-treated at 425/sup 0/C for varying periods and the structural changes in the binder phase were measured microscopically. It has been found that the superior strength electrodes bound with pitches containing primary quinoline insolubles (QI) or carbon black is associated with the inhibition, by these dispersed solids, of the development of extensive mesophase areas. There was evidence that flow of the binder within the baking composite concentrated the primary QI of a commercial binder at constrictions within the coke matrix and provided strategically-placed strong bridges. The electrical resistivity changes during the heat treatment of some pitches have been followed, and have been correlated to viscosity changes and mesophase development in the pitches.

67 **(ICTIS/TR—38) Biotechnology and coal.** Couch, G.R. (International Energy Agency Coal Research, London (UK)). Mar 1987. 56p. NTIS (US Sales Only), PC A04/MF A1. Order Number DE88900107/JAW.

A wide-ranging review of the possible applications of biotechnology to coal use is presented. The review includes a brief introduction to biochemical processes and discusses the possible applications of biotechnology to coal utilization. Coal is not seen as an easy material for microbial attack. Work has been done in many countries on the microbial desulphurization of coal, to remove both pyrite and organic sulphur. The work on pyrite removal has been more extensive. Microbes which attack and use the sulphur contained in coal have been identified, and it is possible to propose processes and define conditions that would achieve a significant reduction in the sulphur content of some coals prior to use. Development work has been undertaken in the US, in the Netherlands and in a number of other member countries including the FRG and the UK. Up to 90% removal of pyritic sulphur can be achieved. At this stage, reaction rates are too slow for a process to look economically competitive, and there may be significant costs associated with effluent treatment. Work is, however, continuing to improve the process economics. Biodesulphurization may be applicable where small tonnages are involved, where the use of coal-water slurries are considered, or for treatment fines. Bioprocesses based on the products of a preliminary chemical degradation of lignite are being considered. This approach has a number of attractions, and involves the identification of microorganisms to effect the various transformations at an adequate rate. Work is going on in the US and in the FRG to find microorganisms which directly attack or degrade coals, and both fungi and bacteria have been identified. Studies are in the very early stages, and little has yet been done to identify the degradation products or to measure reaction rates. The reaction rates observed have been extremely slow. 100 refs., 27 figs., 19 tabs.

68 **(NERDDP-EG—85-401) Structural characterisation of Australian coals.** Stephens, J.F. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1985. vp. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The basic objective of the project is to obtain greater insight into the chemical structure of solid coals, particularly Australian coals, and to link this with more accessible information on the petrographic compositions and physical properties of the coals. Three particular lines of research have been pursued: development of the potential of high power mine techniques for direct characterisation of the chemical structure of coals and related solids; chemical studies of the structure of coals and their macerals; and structural studies of coals by scanning electron microscopy.

69 **(NERDDP-EG—85-418) Determination of trace elements in coal and coal products. Part 7: a study of the feasibility of elemental analysis as an aid in coal seam correlation.** Warbrooke, P.R.; Turner, K.E.; Doolan, K.J.; Knott, A.C. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1984. vp. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

Four well established and commercially viable coal seams in the Newcastle coal measures have been extensively sampled to determine: (i) variability of elemental analyses within and between seams; (ii) detailed elemental profiles of the seams; and (iii) correlation of inorganic and trace elements within and between seams. The four seams (Australasian, Wave Hill, Dudley and Borehole) were sampled at geographically well spaced locations and samples were analysed to compare the elemental variability between and within seams. Also, five sections of both the Dudley and Borehole seams were split into a number of coal plies correlatable across the coalfield and these were analysed to provide detailed elemental profiles of the seams as well as show the natural elemental variation within and between coal plies. Detailed analytical results are presented for all sampling locations and an assessment is made of the feasibility of using analytical data as a means of coal seam identification.

70 **Concentration estimate of chemically reactive methylene and methine carbon centers of defined C-H acidity in coal by CP/MAS ^{13}C NMR spectrometry.** Hagaman, E.W.; Chambers, R.R. Jr.; Woody, M.C. (Oak Ridge National Laboratory, TN (USA)). *Energy and Fuels;* **1**: No. 4, 352-360(Jul-Aug 1987).

The CP/MAS ^{13}C NMR spectra of coal derivatives generated by serial carbon alkylations using methyl iodide reveal complex band shape changes in the methyl resonance region as a function of methylation step number. The spectra of coal derivatives serially prepared with methyl iodide whose specific ^{13}C enrichment is varied as a function of alkylation step number reveal a methyl group chemical shift reorganization that establishes repeated alkylation of some coal sites. From this result a minimum methylene/methine site ratio of 0.2 is estimated. Separate experiments that employ (^{9}-^{13}C) fluorene as the precursor for the alkylation base demonstrate that the reactive sites are a part of the native organic coal matrix and not artifacts of reagent incorporation in the coal. 20 refs., 7 figs., 3 tabs.

71 **Thermal catalytic transformation of pentacyclic triterpenoids: alteration of geochemical fossils during coalification.** Hayatsu, R.; Botto, R.E.; Scott, R.G.; McBeth, R.L.; Winans, R.E. (Argonne National Lab., IL). *Organic Geochemistry;* **11**: No. 4, 245-250(1987).

To elucidate the possible natural evolutionary pathways for the transformation of pentacyclic triterpenoids, three terpenoid samples, δ^2-allobetulene, tetranormethylallobetulheptaene and fernenes were heated independently at 150 C for 7 weeks with montmorillonite clay. Common products from these reactions consisted of di, tri-, tetra-, and pentacyclic hydroaromatic and aromatic hydrocarbons, which are commonly found in higher rank coals. C-ring cleaved (8,14-seco) aromatic terpenoid derivatives were also found in the thermal catalytic reaction products of δ^2-allobetulene. Such compounds could be important intermediates in the formation of bicyclic hydrocarbons from pentacyclic triterpenoids. 28 refs.

0108 Waste Management

REFER ALSO TO CITATION(S) 3, 20, 25, 47, 54, 56, 59, 147, 152, 154, 169, 179, 187, 192, 616, 621, 622, 623, 628, 629, 630, 631, 632, 633, 634, 635, 636, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 657, 664, 665, 666, 667, 668, 669, 1138

72 **(BMFT-FB-T—86-241) Dry-sorption investigations for the retention of hydrogen-halides in the flue gas of a fluidized bed combustion. Final report.** Weber, E.; Schrooten, T. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Essen Univ. (Gesamthochschule) (Germany, F.R.). Inst. fuer Umweltverfahrenstechnik). Dec 1986. 64p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753256/JAW.

Aim of the research project was the improvement of the hydrogen halides removal behind fluidized bed combustions (FBC) by dry sorption. The halides were separated in an experimental plant that cleaned a partial stack gas stream from the FBC. Besides dry solid additives, aqueous suspensions of calcium hydroxide were used for retention of the noxious components. The dust particles were thereafter separated from the stack gas by fabric filtration. The investigations have shown up that for the combustion of coal with low halide contents HCl and HF can be separated besides SO/sub 2/ to a fairly high degree by the addition of surplus limestone

(Ca/S ≧ 4) to the fluidized bed. For large chloride concentrations in the coal the amount of limestone in the fluidized bed would have to be raised to an uneconomically high value (Ca/S > 15) if the HCl clean gas concentration has to fulfil the legislative demands. In that case the hydrogen halides removal could be advantageously carried out by subsequent sorption processes. Of the various studied additives Ca(OH)/sub 2/ achieved the most efficient removal of HCl, whereas the retention of HF could be carried out with all calcium compounds without problems. The spray sorption process showed similar results achieving additionally a significant SO/sub 2/ removal. With 24 refs., 8 tabs., 20 figs.

73 **(BMFT-FB-T—86-250) Investigation on the catalytic RESONOX process to remove SO/sub 2/ and NO/sub x/ from flue gas of coal-fired boilers. Final report.** Bauer, J.; Kaimann, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Kohlegas Nordrhein G.m.b.H., Ratingen (Germany, F.R.)). Dec 1986. 31p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753258/JAW.

In 1983 the only proven processes to remove NOx from flue gas were Japanese SCR processes: NH/sub 3/ is added to the flue gas at a temperature between 350 and 400degC and a catalyst accelerates the production of N/sub 2/ and H/sub 2/O from NO, NO/sub 2/, O/sub 2/ and NH/sub 3/. Target for the catalytic RESONOX process was the simultaneous removal of NO/sub x/ and SO/sub 2/ from flue gas of coal-fired boilers and to produce H/sub 2/SO/sub 4/ with a concentration of about 90%. Process components were the proven catalyst used in automobile exhausts to remove NOx, using natural gas as reducing agent ('RENOX'), a catalyst (DEGUSSA) to convert SO/sub 2/ into SO/sub 3/ ('RESOX') and a glass pipe air preheater to condensate H/sub 2/SO/sub 4/. A pilot plant was operated with flue gas from a coal-fired boiler. It was not possible to run this plant continuously at a flue gas temperature of 450degC, because the RENOX catalyst was inactivated by a cover of molten fly ash, which was formed at 600degC within the catalyst. With the RESOX catalyst satisfactory results were obtained. The glass pipe condensator for H/sub 2/SO/sub 4/ did not operate as anticipated. With 3 refs., 2 tabs., 4 figs.

74 (CONF-8610247—, pp 77-80) **Clean use of coal.** Mills, L.J. 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

The future development of the coal industry depends not only on the truth, but on perceptions of the truth, of environmental issues, such as acid rain. The paper discusses some of the major developments in clean coal technology in Western Europe. There are three approaches to burning coal cleanly: coal processing, either washing, gasification, or liquefaction; control during the combustion process; and treatment of flue gas. The pressurized fluidized-bed facility at Grimethorpe, UK, is briefly highlighted.

75 (CONF-8610247—, pp 189-218) **Structural changes in the technology of heat and electricity generation from coal in the Federal Republic of Germany.** Schilling, H.D. (Bergbau-Forschung GmbH, West Germany). 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

The fact that power and heat generation plays a predominant role for energy supplies has prompted the Federal Republic of Germany to fix particularly severe emission limits for sulfur dioxide, nitrogen oxides, and dust. This paper discusses the technology for sulfur dioxide reduction, NOx reduction, simultaneous sulfur dioxide and nitrogen oxides reduction, fluidized-bed combustion, gas/steam turbine processes with integrated coal gasification, integration of nuclear heat, and cogeneration. 9 references, 29 figures.

76 (DOE/METC—87/6077, pp 123-130) **Electrochemical abatement of pollutants NO/sub x/ and SO/sub x/ in combustion exhaust gases employing a solid-oxide electrolyte.** Mason, D.M. (Stanford Univ., CA). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The purpose of this investigation is to test the feasibility of electrochemically pumping off oxygen from pollutant species, NO/sub x/ and SO/sub x/, rendering NO/sub x/ harmless and forming easily condensable sulfur from SO/sub x/. It is desired preferentially to reduce the pollutant species without having to pump any excess oxygen that may be present. The relative electrocatalytic reactivity of pollutant species compared to oxygen will be experimentally determined. Initially a thorough understanding of O_2 electroreduction kinetics is being obtained before studying NO and NO/O_2 mixtures. An oxygen-ion type solid electrolyte composed of Y_2O_3-stabilized ZrO_2 (YSZ) is being used in a disk-shaped differential flow reactor to study the electrocatalytic pumping off of oxygen from the pollutant species. The project is described and results to date are given. 4 references, 6 figures.

77 (DOE/METC—87/6077, pp 131-135) **Super-equilibrium sulfur removal from high temperature gases.** Jeong, K.M.; Stickler, D.B. (Avco Research Lab. Inc., Everett, MA). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23262.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of this program is to investigate the potential of chemical sorbents for sulfur removal from high temperature gases (1600-2400K) under transient thermal nonequilibrium conditions. While thermodynamic equilibrium sulfur capture is essentially zero for a fuel-rich mixture at these high adiabatic gas temperatures, the proposed super-equilibrium method is based on the premise that retention is dependent on the particle temperature rather than the gas temperature. The scope of this work is to determine, from single pulse experiments, the effects of various sorbent properties and coal combustion conditions on sulfur capture. Test facilities being used and preliminary results are described. 3 references, 4 figures.

78 (DOE/METC—87/6077, pp 136-140) **High temperature interaction of SO_2 with oxide sorbents.** Seehra, M.S.; Thevar, G.R. (West Virginia Univ., Morgantown). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23259.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The major goal of this project is to obtain detailed data on the kinetics of surface species formed during the high temperature (ca 700 C) interaction of SO_2 and O_2 with MgO and calcined dolomite. Similar studies are also planned in the reducing atmosphere of H_2S because of the equivalent technical importance of this problem. The program involves the simultaneous use of Electron Spin Resonance and FTIR Spectroscopies and a high vacuum system in which controlled amounts of gases are introduced at selected temperatures up to 700 C. Thus in-situ detection of the surface chemical species, their transformation modes and kinetics are to be studied. The importance of these results in relation to the advanced coal-use technologies will also be examined. 8 references, 2 figures.

79 (DOE/METC—87/6077, pp 203-210) **Limestone/dolomite for direct coal-fired turbines.** Newby, R.A.; Kittle, W.F. (Westinghouse R & D Center, Pittsburgh, PA). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-85MC22087.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of this project is to test and evaluate the performance of calcium-based sorbents for sulfur control in direct coal-fired turbines at temperatures up to 1200 C. Calcium-based sorbents are limestones, dolomites or processed forms of these, such as limes and hydrates. Two generic types of gas-solid contacting devices are considered in the program: fluidized bed desulfurizers where relatively coarsely-sized sorbent particles (300 to 1000 micron diameter) are used in shallow, turbulent fluidized contactors; and entrained desulfurizers where relatively finely-sized sor-

bent particles (1 to 50 microns) are injected into the combustion gases. While the program focuses on external desulfurization following complete coal combustion, it also relates directly to internal desulfurization in advanced staged-combustors by its consideration of finely-sized sorbent particles in both SO_2 and H_2S gases. Both fine and coarse particle results are discussed. 3 references, 1 table.

80 (DOE/METC—87/6077, pp 211-234) **Use of solid collectors for control of emissions in advanced coal conversion processes.** Klinzing, G.E.; Blachere, J.R. (Univ. of Pittsburgh, PA). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-84MC21387.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of the project was the control of emissions of alkali metals, trace metals and aromatic hydrocarbons that occur in advanced coal conversion processes as exemplified in pulverized coal combustion. The process that was explored is the adsorption of the undesirable components onto the surface of a solid collector, such as activate alumina, which is injected into the flame mixed with the feed coal. The project has been completed and this is a final summary of the findings. After giving a description of the combustor system and materials characterization, results are discussed under the following headings: visual flame observations, operating parameters, measurements, scanning electron microscope, porosity measurements, isothermal experiments, combustor factors, sodium adsorption in the combustor, pore size and surface area effects an adsorption, and requirements for emissions control. 20 references, 7 figures, 7 tables.

81 (DOE/METC—87/6077, pp 235-245) **Cross flow filter development programs.** Lippert, T.E.; Meyer, J.H. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

Many of the advanced coal conversion technologies currently under development depend on the availability of a system for reliable, efficient, and economic removal of particulate matter from high temperature and pressure gas streams. The objective of this set of programs is to develop a novel high temperature and pressure ceramic filter concept to the point where proof of concept has been established for various advanced coal conversion technologies. This effort has included bench scale experimental demonstration of the filter in both PFBC and gasifier applications, and plans for larger scale multi-element demonstration of the concept at subpilot scale test sites. These programs include both analytical and mechanical component testing in support of the technology development. The cross flow filter concept and its technical development are described. A summary of results are presented from the 1000 cleaning cycle test of a small cross flow filter and from the recent introductory HTHP test of the first commercial scale cross flow filter element. 5 references, 6 figures.

82 (DOE/METC—87/6081, pp 1.A2.1-1.A2.16) **History of Texas lignite utilization from a solid waste management perspective.** Weber, D.F. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Texas lignite utilization generates an operating solid waste environment that relies heavily on the use of surface impoundments and landfill disposal. Surface impoundments and landfills have traditionally been designed to support lignite power generation in terms of on-site water management practices and solid waste disposal, respectively. The need for power plant operations to be located near large bodies of water for makeup and cooling water purposes frequently results in locating essential operational ponds and land disposal facilities within distinct hydrogeological locations capable of potentially impacting ground and surface water resources. Solid Waste Management practices have evolved and currently reflect site selection and corrective action considerations based on environmental assessments, changes in design and operating standards, economics, and changes in social and regulatory climates. A once pure geotechnical/civil engineering approach to solid waste management has now given way to a more interdisciplinary concept which integrates engineering with hydrogeology, geophysics, soil, water and leachate chemistry, computer modeling; and regulatory affairs. As solid waste management regulations continue to focus on the potential impacts of solute transport on valued ground- and surface-water resources, it is increasingly important to expand their understanding of the complexities of lignite combustion waste leachate chemistry and the dynamics of leachate migration, in addition to pursuing markets for the recycling of these combustion wastes. 12 references, 10 figures, 2 tables.

83 (DOE/METC—87/6081, pp 2.A2.1-2.A2.16) **Modified combustion emission control system with sorbent injection demonstration plant for NO/sub x//SO_2 reduction for lignite coal.** Douglas, M.A.; Feindel, R.; Gass, D.J. (Combustion Engineering Canada Inc., Ottawa, Ontario). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Since 1982, Saskatchewan Power Corporation and C-E Canada Power Systems have jointly conducted research to reduce NO/sub x/ and SO_2 emissions from steam generators firing lignite coal. This paper summarizes the previous results of this joint research effort and presents the results of a recent program to demonstrate a relatively low cost technology to control both NO/sub x/ and SO_2 emissions for low rank fuels on a full scale 150 MW lignite coal fired steam generator. Design considerations for Saskatchewan lignite coals are reviewed. The Modified Combustion Emission Control System with Sorbent Injection demonstration plant is described. The test program carried out with the demonstration plant using two Saskatchewan lignite coals, Boundary Dam and Shand, and two sorbents, limestone and pressure hydrated lime, is outlined. Test results are presented for NO/sub x/ and SO_2 emissions reduction and the effects of the demonstration plant on steam generator operation. The impact of these results on new lignite coal fired steam generator design is discussed. 8 references, 6 figures, 4 tables.

84 (DOE/METC—87/6081, pp 2.A3.1-2A3.18) **Furnace sorbent injections: a pilot-scale evaluation of its effect on ash deposition and ESP performance.** Collings, M.E.; Weber, G.F.; Schelkoph, G.L. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Pilot-scale (550,000 Btu/hr) pulverized-coal combustion tests were performed to establish the impact of furnace sorbent injection on combustion system operability. Texas lignite, Montana subbituminous, and Illinois #6 bituminous coals were fired using high-calcium pressure-hydrated lime as sorbent. Sorbent was pneumatically injected into the furnace to reduce SO_2 emissions by 50% and 90%, representing target control for retrofit and new installations, respectively. On a moisture-free basis, Texas lignite contained about 1.5% sulfur, 15% ash and had a heating value of 10,600 Btu/lb. A reduction of about 50% in sulfur emissions was achieved at a 1.8 Ca/SO_2 mole ratio. Sorbent injection did not affect ash deposition, as ash deposits sloughed off probes continuously in all cases. Montana subbituminous coal contained 0.87% sulfur, 12% ash and had a heating value of 11,400 Btu/lb (moisture-free basis). A Ca/SO_2 mole ratio of 2.1 resulted in about 50% sulfur capture. As with the lignite, this coal was low fouling with or without sorbent injection. Strength tests on the ash deposits showed that the deposits became weaker and more friable with sorbent injection. The bituminous coal had a heating value of 12,300 Btu/lb, a sulfur content of 3.7%, and an ash content of 12% (moisture-free basis). A Ca/SO_2 mole ratio of 1.1 captured 50% of the sulfur. This coal/sorbent combination was low fouling and produced weak deposits. Sorbent added to reduce sulfur emissions by 50% resulted in a full order of magnitude increase in bulk ash resistivity for the three coal. Electrostatic precipitator efficiency data were variable but generally showed poorer performance when SO_2 capture exceeded 50%.

85 (DOE/METC—87/6081, pp 3.B1.1-3.B1.14) **Enhancing utility baghouse performance for Texas lignite ashes.** Felix, L.G.; Bush, P.V.; Merritt, R.L. (Southern Research Institute, Birmingham, AL). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Recently some utility baghouses have encountered particulate collection problems with the fly ash from certain Texas lignites from the Wilcox formation. Detailed fly ash characterization have indicated that the surfaces of the lignite fly ash particles are much smoother than fly ashes from low-sulfur western subbituminous or eastern bituminous coals, as well as being less cohesive. These features contribute to the formation of a filter cake with an inherently low porosity which tends to slowly bleed through typical bag fabrics. The result is a compound problem of high pressure drop and high stack opacity. The Electric Power Research Institute (EPRI) has sponsored research devoted to enhancing utility baghouse performance with this Texas lignite fly ash. This research has produced two methods to enable baghouses filtering this lignite fly ash to achieve particulate collection efficiencies that guarantee clear stacks. The first approach, flue gas conditioning with NH_3 gas, has provided this level of performance with conventional fiberglass fabrics. The principal effect of flue gas conditioning is to increase the cohesivity of the fly ash by the reaction of NH_3 gas with SO_3 present in the flue gas and on the fly ash particles. With the second approach, a conventional fiberglass fabric that has been coated on the filtering side with a microporous polytetrafluoroethylene (PTFE) film (Gore-Tex) has also provided this level of performance. These two approaches have been tested in a year long fabric and flue gas conditioning study which was concluded recently at the TU Electric Monticello station Unit 1 baghouse. It has been determined that both approaches provide the capability of clear stack performance with no detrimental effect on baghouse operation, pressure drop, or on ash removal. 8 references, 4 figures, 5 tables.

86 (DOE/METC—87/6081, pp 3.B2.1-3.B2.20) **Flue gas conditioning for baghouse performance improvement with low-rank coals.** Laudal, D.L.; Miller, S.J. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Many low-rank coals produce high-resistivity fly ashes, which makes electrostatic precipitation unattractive for these fuels. As a result, fabric filtration has become a choice method of particulate control for low-rank coals. Fabric filtration performance, however, is dependent on the physical and chemical properties of the fly ash. Some low-rank coals produce fly ash which is difficult to collect with conventional fabric filtration. The exact fly ash characteristics which cause collection problems in a baghouse are not well known, but are thought to include particle size and cohesiveness. Ashes which are more difficult to collect have a low cohesiveness compared to other ashes. Pilot-scale tests have been conducted in which small amounts of ammonia and sulfur trioxide were injected into the flue gas upstream of the baghouse. Results show that, for several low-rank coals which produce difficult-to-collect ash, particulate emissions were substantially reduced when using these conditioning agents. As a bonus, baghouse pressure drop was also reduced making the process much more attractive. Since injection technology for conditioning agents such as ammonia and sulfur trioxide has been well developed in the electrostatic precipitator industry, this method is readily available. Longer term and larger scale testing, however, is needed to more fully evaluate the potential of conditioning agents to improve fabric filter performance. An economic analysis shows that the use of ammonia and sulfur trioxide as conditioning agents would add about 9% to the cost of operating a baghouse. However, this cost could be more than recovered if the size of the baghouse could be reduced because of the lower expected pressure drop. 13 references, 10 figures, 6 tables.

87 (DOE/METC—87/6081, pp 3.B3.1-3.B3.16) **Conversion of San Antonio City Public Service J.T. Deely Unit No. 2 electrostatic precipitators from hot side to cold side operation.** Pruske, J.E.; Schwegmann, J.R. (City Public Service, San Antonio, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The two units each consist of a Combustion Engineering, Inc. balanced draft, drum type steam generator, a single trisector Ljungstrom air preheater, and two Buell hot side, weighted wire precipitators. The decision to use hot side weighted wire precipitators for flue gas particulate removal was based on available technology and utility/consultant thinking during the early to middle 1970's. Soon after the units went into operation in 1977 and 1978, CPS began to experience the well publicized problems associated with hot side precipitators. In general, the problem can be characterized by a gradual deterioration of performance. This deterioration was caused by the combined effects of ash buildup on the discharge electrodes, development of a sodium depleted ash layer on the collecting plates, poor plate to wire clearances due to thermal expansions and contractions, and inadequate wire cleaning. After about 10 to 14 weeks of high load operation, the emissions from the precipitators would exceed opacity limitations. This forced CPS to shutdown the coal unit and thoroughly wash each precipitator. The J.T. Deely coal units are the most economical generating units on the City Public Service system. As the years went by, the frequency of washing the precipitators increased. These frequency shut downs for a precipitator wash not only affected the integrity of the precipitators but also the performance of the entire coal unit. The inability of the J.T. Deely hot side precipitator to maintain satisfactory performance became unacceptable to CPS. This paper summarizes the studies and work performed to convert the precipitators from hot side to cold side operation. 2 figures, 2 tables.

88 (DOE/METC—87/6081, pp 3.B4.1) **Fabric and finish selection, manufacturing techniques and other factors affecting filter bag performance in lignite fired boiler applications.** Capps, C.E. (Menardi-Criswell Corp., Houston, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Filter bags are a small part of the overall cost of operating a fabric filter; however, they are one of the most important factors in the successful operation of the unit. Filter bags should be designed for specific applications. Many variables must be considered. This paper addresses three areas which are considered of prime importance. First, the fabric selection. Through the years a number of fiber glass fabrics have been developed for utility boiler applications. This paper addresses the fabric design and how it relates to bag life and performance. The second important variable which must be considered is the finish. There are in use today, three groups of finishes with many variations in each. These are the Teflon based finishes, those described as acid resistant finishes and the tri-component finishes. This paper discusses the function, composition, application and use of these various finishes. The final factor to be addressed is filter bag fabrication. This paper highlights those areas which are not normally considered by the end user when purchasing or developing a specification for a high temperature fiber glass filter bag.

89 (DOE/METC—87/6081, pp 4.B1.1-4.B1.18) **Economic analysis of SO_2 control by dry sorbent injection.** Dorchak, T.P.; Lanier, W.S.; Robinson, S.B. (Dept. of Energy, Grand Forks, ND). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

A baseline analysis considered sorbent injection at an existing 500 MW(e) boiler firing low sulfur North Dakota lignite. The relative economics were evaluated for three levels of on-site sorbent processing assuming that the sorbent being injected was a pressure-hydrated, high calcitic material. The three options examined were: direct purchase of the pressure hydrate; procurement of pebble quicklime and on-site pressure hydration; and purchase of limestone with on-site calcination and pressure hydration. The baseline analyses were performed at assumed sorbent injection rates sufficient to achieve 50 to 70% SO_2 control while firing the low sulfur baseline coal. The lower injection rate is representative of an SO_2 reduction level which may be required by pending acid rain legislation while the higher injection rate would provide sulfur control commensurate with EPA's New Source Performance Standard. Results from this baseline analysis indicate a significant economic advantage for purchase of pebble quicklime with on-site pressure hydration. This sorbent processing option requires capital expenditure for on-site pressure hydration equipment but these costs are more

than offset by the lower unit cost of lime relative to purchased pressure hydrate. The option of purchasing limestone with on-site calcination and pressure hydration becomes increasingly attractive with increasing sorbent consumption. The study indicates that lime requirements above approximately 500 tons per day are required before this option is economically viable. Sensitivity analyses are included evaluating the impact of assumed boiler size, boiler capacity factor, coal sulfur content, sorbent unit cost and calcium utilization efficiency. 8 references, 6 figures, 7 tables.

90 (DOE/METC—87/6081, pp 4.B2.1-4.B2.15) **Optimization of the Gibbons Creek limestone FGD system.** Colley, J.D.; Delleney, R.D.; Jones, A.F. (Radian Corp., Austin, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The Texas Municipal Power Agency operates a 400 MW, mine-mouth lignite boiler in East Central Texas. This unit, Gibbons Creek 1, is equipped with a cold-side ESP and a limestone spray tower FGD system to control emissions from the combustion of a nominal 1% sulfur lignite. The FGD system experienced numerous operating and reliability problems until TMPA initiated an optimization program in late 1984. As a consequence of TMPA's characterization of the FGD system with the assistance of Radian Corporation and the subsequent implementation of many of the recommendations that resulted from this characterization, significant reductions in operating and maintenance costs have been achieved. The system operability and reliability have also been improved. This paper presents the results of the characterization study and a discussion of the FGD system improvements that have been realized. 1 figure, 6 tables.

91 (DOE/METC—87/6081, pp 5.B1.1-5.B1.15) **SO_2 scrubber performance - the bottom line.** Wadlington, M.; Ferguson, B. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

TU Electric Generating Division operates 12 lignite fired steam generating units at four locations: Monticello, Martin Lake, Big Brown and Sandow Steam Electric Stations. Five of these units (three at Martin Lake, and one each at Monticello and Sandow) have SO_2 scrubber systems treating the flue gas. The first of these scrubber systems was placed in service on Martin Lake Unit No. 1 in 1977. The last was placed in service on Sandow unit No. 4 in 1981. These scrubbers, sometimes referred to as Flue Gas Desulfurization (FGD) systems, are all of the limestone slurry-spray tower type but have some significant differences as designed by the three separate vendors that provided the original equipment. Original Equipment Manufacturers were Research-Cottrell at Martin Lake, Chemico at Monticello, and Combustion Engineering at Sandow. All three systems are described, including major process/hardware changes and subsequent improvements. Operating experiences are summarized especially with regard to scrubber performance monitoring. Performance indices were developed and are utilized to evaluate SO_2 compliance and Megawatt limitations due to the scrubbers. Operating and maintenance costs for the past three years are also compared. 7 figures.

92 (DOE/METC—87/6081, pp 5.B2.1-5.B2.4) **FGD operation and maintenance costs: a function of first cost - or is it.** Norton, R.; Gaige, C.D.; Smith, S.T.; Kunzweiler, V.L. (Burns & McDonnel Engineering Co., Kansas City, MO). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The initial cost of an FGD system is affected by the quality of the materials and the standard of workmanship required to produce a functioning system. It is generally accepted that this will improve the unit reliability and dependability. This paper investigates the relationship between the first cost and the system's operation and maintenance cost. These costs are reported on the Federal Energy Regulatory Commission (FERC) Form 67. This information was compiled and compared by Burns & McDonnell. The study was isolated on lime and limestone FGD systems. This was done because approximately 90% of the flue gas desulfurization systems in existence are lime or limestone. 2 references.

93 (DOE/METC—87/6081, pp 5.B3.1-5.B3.6) **Houston Lighting and Power Company, Limestone Electric Generating Station: trial operation and experience report, flue gas desulfurization system.** 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The FGD system consists of five spray tower absorbers (four operating/one spare) and sets of primary and secondary reaction tanks per absorber. Limestone slurry is used for sulfur dioxide removal. In January, 1986, data obtained from certification tests of the stack continuous emissions monitoring system indicated that the FGD system SO_2 removal efficiency was out of compliance with regulations. Performance testing was commenced and some modifications made. Following Unit 1 FGD mechanical modification testing, a comprehensive test program to assess the FGD system diabasic acid (DBA) requirements over the life of the plant was planned jointly with Combustion Engineering. The principle objectives of the program are: to determine the relationship between DBA concentration and FGD SO_2 removal efficiency; to quantify the relationship between DBA concentration, limestone utilization, and system power consumption as a function of SO_2 removal efficiency; to quantify the DBA addition rate to maintain a desired concentration of DBA in the recycle spray slurry; to identify a location and method in which DBA may best be added to the system; and to investigate system operating and waste disposal consideration resulting from DBA addition. The test program was set up to be performed in four phases. The first phase verified monitoring and data collection instrumentation calibration as well as verifying SO_2 removal efficiency of the individual absorber towers. Work is progressing on the others.

94 (DOE/METC—87/6081, pp 4.C3.1-4.C3.6) **Class C fly ash markets.** Leber, L.E. (Nebraska Ash Co., Lincoln). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Their company is in the business of marketing Power Plant Ash predominantly in Nebraska. Four sources are under contract, all producing a Class C Fly Ash. This paper describes the various uses for Fly Ash in the market area. Some of the uses which are covered are a partial cement replacement in Portland cement concrete, filler in asphaltic concrete, and soil stabilization. Portland cement products which are covered are concrete Paving, Ready Mixed Concrete, Prestressed Concrete, Concrete Block, and Concrete Pipe. The various soil stabilization uses which are discussed are the drying of highway subgrades and building construction sites, temporary grain storage pads, stabilization of high P.I. soils, and pozzolanic base and armor coat for upgrading gravel roads. In 1986 a 2 mile pozzolanic base roadway was constructed in central Nebraska. The procedures and test data are available and are included in this paper. 2 tables.

95 (DOE/METC—87/6081, pp 7.C3.1-7.C3.2) **HMAC bottom ash overlay I-30, Hopkins County.** Long, R.E. (Texas State Dept. of Public Transportation). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

In 1980, District I began evaluating the use of bottom ash in hot mix asphaltic concrete pavements. Three test sections containing bottom ash were placed on Farm Market 1870, State Highway 11 and Interstate 30 in Hopkins County. After a five year study of the three test sections and an evaluation of both field and laboratory data, an overlay project on Interstate Highway 30 in Hopkins County was constructed. The objective of this experimental project was to (1) evaluate the characteristics of bottom ash properties when incorporated into the ACP overlay surface and (2) evaluate the performance of the ACP when subjected to high volume traffic relating to internal and external structural properties of durability, stability, and fatigue resistance, workability, tensile, cohesion, water

susceptibility and surface skid data and (3) develop cost data for the completed construction. Since placement of the test section on 5-8-86, the pavement has shown no signs of distress. Laboratory data from both the road mix and field cores indicate acceptable values and the air void content of the compacted pavement are within acceptable limits. Although the mix was somewhat tender and heat loss was rather rapid, adequate compaction was accomplished using a vibratory and pneumatic roller. A rolling pattern using a nuclear gauge was established. The base course bonded well with the concrete pavement and the C and D courses were also tightly bonded. The design and construction of bottom ash mixes are possible using the knowledge of modern HMAC technology. An evaluation of this project during the next five years should give us a better insight into the reliability and future of the bottom ash mixes.

96 (DOE/METC—87/6081, pp PS.9-PS.23) **Pilot-scale evaluation of furnace sorbent injection for SO_2 control firing Canadian low-rank coals.** Miller, B.G.; Weber, G.F.; Gass, D.J. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

UNDERC conducted three series of tests to determine the effects of inherent and added alkali (furnace sorbent injection) on sulfur retention for lignite samples from four mines for Saskatchewan Power Corporation. The purpose of the study was to determine the potential for meeting a 0.60 lb SO_2 per million Btu (MM Btu) emission standard. A total of seven lignite samples were tested. The study included pilot-scale combustion tests of the coals in UNDERC's particulate test combustor (PTC). Sorbents used in the study included a Canadian limestone, an Iowa limestone, a high-calcium pressure hydrate prepared in the UNDERC bench-scale pressure hydrator, and two high-calcium hydrates produced in commercial facilities. Baseline tests with each fuel demonstrated that inherent alkali alone was not sufficient to meet the 0.60 lb SO_2/MM Btu emission standard even though SO_2 reduction values as high as 42% were observed. Furnace injection of the limestone was found to sufficiently capture SO_2 at a CaO/SO_2 mole ratio of 2.0 for three of the four test coals tested. The 0.60 lb SO_2/MM Btu emission standard was met for all four test coals when a hydrate was injected at a CaO/SO_2 mole ratio of 0.7 to 2.2. All hydrates were injected into the PTC at a point where bulk flue gas temperature was 1825°F. Limestone was added to the coal feed venturi and entered the combustor through the burner. Utilization values for the hydrates and limestones ranged from 19% to 59% and 10% to 26%, respectively, for CaO/SO_2 mole ratios of 0.3 to 3.7. 10 references, 5 figures, 4 tables.

97 (DOE/PC/90514—T4) **Anaerobic fluid-bed treatment of coal conversion wastewater: Fourth quarterly technical progress report for the period May 15 to August 15, 1987.** Suidan, M.T.; Pfeffer, J.T.; Nakhala, G.F.; Traegner, U.K. (Illinois Univ., Urbana (USA). Dept. of Civil Engineering). 1987. Contract FG22-86PC90514. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000628/JAW.

Anaerobic fluidized-bed GAC reactors have been proven successful for the treatment of biologically inhibiting wastewaters such as coal conversion wastewaters. However, in treating such wastewaters which contain compounds that not only resist biodegradation but also inhibit the degradation of other compounds, adsorption on granular activated carbon (GAC) is a viable strategy for the removal of these inhibitory compounds. Since the adsorptive capacity of the reactor media is limited, partial replacement of the carbon bed is then necessary to maintain the concentration of inhibitory compounds below threshold levels. The cost of the GAC replacement thus represents a major operating cost of the system. The hydraulic detention time and the associated carbon inventory represent the single most important capital cost parameter. The objectives of this research are to determine, using experimental and modeling strategies, the effects of hydraulic detention time and the schedule of GAC replacement on the performance of fluidized bed GAC anaerobic reactors during the treatment of coal conversion wastewater. 7 figs., 2 tabs.

98 (EUR—10501-DE) **Demonstration plant for an energy-saving flue gas desulphurization process - demonstration project.** Fischer, J.; Schulte, W. (Walther Cie A.G., Cologne (Germany, F.R.)). 1986. 216p. Commission of the European Communities.

The contract was carried through in the frame-work of the energy demonstration programme. The aim of the project was the development and construction of a Walther flue gas desulphurization demonstration plant according to the Walther waste-water-free principle including startup and test operation of the plant, in order to prove that the Walther desulphurization process allows reheating of the cleaned gases as well as spray drying of the ammonium sulphate solution produced during the scrubbing stage, by utilizing the waste heat of the flue gases without need for additional energy. After an operating period of two years it may be said that the flue gas desulphurization plant on the basis of the Walther process in the power station at Mannheim has come up to expectation regarding cleaning effectiveness and end-product quality of the final product which is utilized as fertilizer. Thus, several different SO_2 contents were reached which are clearly below the guaranteed value of 180 mg/Nm^3 dry. Due to reheating the scrubbed flue gases by means of a regenerative heat exchanger, approximately 1800 kg/h El fuel oil could be saved in full-load operation. Difficulties occurred almost exclusively in the conventional parts of the plant and can be explained by the flowability of the ammonium sulphate powder.

99 (IS—4920) **Stabilization of coal cleaning and power plant combustion wastes: Fossil Energy Program technical progress report, 1 January 1987-31 March 1987.** Burnet, G.; Gokhale, A. (Ames Lab., IA (USA)). Mar 1987. Contract W-7405-ENG-82. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000657/JAW.

The Ames Laboratory granulation/sintering process for the stabilization of coal cleaning refuse is being adapted to the codisposal of refuse and power plant combustion wastes. The combustion wastes are fly ash, flue gas desulfurization sludge, and liquid wastes from the regeneration of ion exchange beds, the cleaning of boiler internals, and boiler blowdown. A plan of work was developed that calls for the batch preparation of green granules of sufficient durability and for sintering of the granules to attain high strength. A second phase of the work will involve continuous agglomerator runs to produce granules for large scale sintering and subsequent leaching and freeze/thaw testing. Suitable solid raw materials were identified and fully characterized. The level of grinding of the coal refuse required for granule formation was determined.

100 (KFK-PEF—12-Vol.2, pp 591-605) **Simultaneous desulfurization and denitrification of flue gas by electron beam dry scrubbing.** Paur, H.R.; Jordan, S.; Schikarski, W. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Lab. fuer Aerosolphysik und Filtertechnik 1). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The efficiency of the NO/sub x/-removal (given in ppm/Mrad) increases with the inlet concentrations of NO/sub x/ and SO/sub 2/, but decreases with increasing dose. By multiple irradiation of the flue gas the efficiency of the EBDS-process was improved. The influence of dose, flue gas humidity and reaction time on the physical and chemical properties of the aerosol was investigated.

101 (KFK-PEF—12-Vol.2, pp 607-625) **Simultaneous flue gas cleaning (desulfurization, denitrification) by means of electron beams.** Wittig, S.; Spiegel, G.; Platzer, K.H.; Willibald, U. (Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Thermische Stroemungsmaschines). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

To decouple the flow and radiation fields a special type of reactor was developed. With this reactor detailed parameter studies were conducted to evaluate the performance characteristics under ideal homogeneous conditions. For the first time, the influence of dose rate on the behaviour of the important reacting species could be determined. The current results are compared with those from the former global experiments. The experimental setup makes it possible to easily test theoretical calculations, for which a new kinetic model was developed. This model allows the inclusion of time dependent radiation conditions.

102 **(NP—8770023) Tailings from coal mining. Weathering and solution processes in the tailings as illustrated by lysimeter experiments.** Schoepel, M. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 15 Feb 1985. 481p. (In German). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88770023/JAW.

Drainage water from spoil banks and groundwater below the banks were sampled and analyzed. Bacterial degradation of sulfates was observed below the spoil banks. With filler materials, the volume and composition of the drainage water changed considerably. Sealing materials at the bottom of spoil banks must be water-permeable. Weathering and solution characteristics of a fly ash from a coal power plant were determined in a lysimeter experiment. A detailed bibliography is presented. (MOS).

103 **(PB—87-224630/XAB) Pilot-scale evaluation of LIMB (Limestone Injection Multistage Burner) technology. Final report, July 1982-July 1985.** Dahlin, R.S.; Beittel, R.; Gooch, J.P. (Southern Research Inst., Birmingham, AL (USA)). Jul 1987. 151p. (SORI-EAS—86-675). NTIS, PC A08/MF A01.

This report gives results of pilot-scale studies of sulfur capture in the EPA's Limestone Injection Multistage Burner (LIMB) process and the effect of LIMB on particulate properties and electrostatic precipitator (ESP) performance. The sulfur-capture studies showed that hydrated lime was generally superior to limestone as a sorbent for in-furnace sulfur removal. For both sorbents, downstream injection was found to be preferable over near-flame injection. With hydrated lime, the optimum injection temperature was found to be about 1200 C, where utilizations as high as 30% were achieved. The injection of either sorbent resulted in a large increase in the electrical resistivity of the ash, which could severely impact ESP performance. Laboratory and pilot-scale studies showed that the resistivity increase could be offset by flue-gas conditioning using sulfur trioxide (SO_3) or water vapor. With limestone injection, acceptable resistivity levels were restored by the injection of 30 ppm of SO_3.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 25, 82, 179, 1791

104 (DOE/METC—87/6081, pp 5.C2.1-5.C2.13) **Reclamation experience in Iowa: past, present, and future.** Henning, S.J.; Pope, R.O.; Hansen, R.J. (Iowa State Univ., Ames). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Surface coal mine reclamation in Iowa had dealt with revegetation of abandoned mine lands up until the 1960's. In the late 1960's, Iowa's first reclamation laws were enacted and required grading and planting of mine sites. Additional reclamation laws with more stringent requirements were enacted in the 1970's and subsequently were brought into compliance with the Surface Mining Control and Reclamation Act of 1977 (SMCRA). In anticipation of the SMCRA, Iowa State Univ leased 37 acres of land underlain with coal and operated its own surface mine from 1975 to 1977. Execution of a mining plan that considered future land-use with the soil available was demonstrated. Post-reclamation research at this site since 1978 has dealt with crop production capabilities and soil redevelopment. The restoration of crop production capabilities from reclaimed soils is dependent upon the amelioration of soil compaction and especially that of the subsoil. The redevelopment of Iowa's coal mining industry is expanding the extent of affected lands. Research is continuing now to restore the agricultural capabilities of mine land for the future. 5 references, 2 tables.

105 (DOE/METC—87/6081, pp 5.C3.1-5.C3.10) **Recent analytical developments as related to mined land reclamation.** Rogers, J.R. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

In order to carry out the responsibility of soil and overburden handling revegetation, State and Federal Agencies have requested accurate information on the chemical and physical properties of soil and overburden materials. Guidelines have been compiled and periodically revised in attempts to improve mutual understanding of overburden and soil sampling, analyses and handling programs which enhance successful revegetation and reclamation of areas disturbed during surface mining operations. Programs have been established which discuss sampling density, sampling intervals and drilling techniques for overburden. These programs are fairly straight forward and easily reconciled in the event of disagreement. Further, the method of soil inventory (as necessary) has been fairly well resolved with most guidelines accepted. The area of concern is that of the policies on analytical determinations. Analytical programs were established that were designed to obtain all available information about soil and overburden materials. These programs were refined every time there was a change in personnel in State or Federal Regulatory Offices. Voluminous data have accumulated over the last couple of decades: most of which was not necessary when obtained, is not used in mine plans and is not necessary for good reclamation. On the next few pages many of the parameters requested are discussed separately.

106 (DOE/METC—87/6081, pp 6.C1.1-6.C1.7) **Federal regulation of utility ash disposal. A status report.** Hemminger, T.E. (Common Wealth Edison Co.). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

By virtue of a 1980 amendment to RCRA, electric utility ash disposal is exempt from federal regulation pending completion of an EPA study on the effects of ash management and a recommendation to Congress on appropriate regulation. EPA's study is nearing completion. Based on numerous tests of its ash, the utility industry believes its coal ash to be nonhazardous and has provided EPA with evidence supporting this conclusion. The industry further intends to participate in EPA's call for suggestions on revisions to its nonhazardous waste regulation program, and will offer demonstrations that its combustion by-products can be safely disposed of using commonly available engineering analysis tools.

107 (DOE/METC—87/6081, pp PS.27-PS.28) **Wildlife habitat considerations and native grassland reclamation at the Jewett Mine, Leon Co., Texas.** Rhodes, M. (Northwestern Resources Co., Jewett, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The post-mine land use was planned to be compatible with the pre-mine land uses. A multiple use concept was used in planning the post-mine use resulting in a plan that provided for 50% native pasture, 25% improved pasture and 25% wildlife habitat. The native pasture would be comprised of improved varieties of native grasses. The improved pasture would be composed of coastal bermuda grass and the wildlife habitat would contain various shrub species, oak spp. and native grasses. Wildlife habitat is to be established at 25% of the post-mine land use because of the value of the pre-mine wildlife habitat, aesthetics and potential economic return from hunting leases. Wildlife habitat establishment on reclaimed lands is discussed in terms of problems which are both common and uncommon to pasture land reclamation. Common problems include proper erosion control, timing and cost. Problems not common to pasture land reclamation include, wildlife species habitat requirements, selection of proper plant materials, acquisition of proper plant materials, proper placement of wildlife habitat in rela-

tion to unmined areas and other post-mine land uses and suitable tree and shrub placement, and spacing within the wildlife habitat areas. Target species habitat requirements and planting methods to establish the necessary habitat are discussed. The costs and benefits of wildlife habitat reclamation are discussed in relation to other post-mine land uses.

108 **(LH-LUVO-R—148) Consequences of deposition of fugitive coal dust for agriculture and horticulture.** Vossen, F.J.; Harssema, H. (Landbouwhogeschool Wageningen (Netherlands)). Nov 1985. 49p. (In Dutch). Landbouwhogeschool, Vakgroep Luchthygiene en -verontreiniging, P.O. Box 9101, 6700 HB Wageningen, Netherlands.

Coal dust can reduce the profits in horticulture both in greenhouses and on 'cold ground' by: decreasing light transmission through the glass roofs of greenhouses and through the surface of the green leaves and thus reducing respiration and assimilation processes; making the surfaces of the products filthy and unattractive and thus decreasing their values; influencing the temperature of the green leaves and thus influencing the whole of the plant's physiology with unpredictable consequences. All these parameters are discussed. Coal deposition is measured and light transmission and degree of deposition determined, including the size distribution of the coal particles. It is concluded that the harmful effects for agriculture and horticulture are neglectible or nearly neglectible.

109 **(PB—87-220398/XAB) Numerical simulation of peat-dust explosions. Research report.** Kjaeldman, L. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Nuclear Engineering Lab.). 1987. 89p. (VTT—469). NTIS, PC E04/MF A01.

The goal of this work was to develop a numerical model for peat-dust deflagrations based on experiments done in a closed 20 dm^3 spherical vessel. The gas-particle mixture is described as a continuous two-phase flow. The model includes drying, pyrolysis, and combustion of the devolatilized gases and char. Local-time-dependent average values for the size and other properties of the particles are used. The results from the simulation are physically reasonable and promising. Reasons for the disagreements between the results from simulation and experiments are discussed and suggestions for further experimental research and model development are given.

110 **(PEO-OWS—128) Summary of the findings on fugitive coal dust, 1983-1985.** Lely, U.P. (PEO, Utrecht (Netherlands)). Dec 1985. 45p. (In Dutch). PEO, P.O. Box 8242, 3503 RE Utrecht, Netherlands.

This report presents the experiences of the program 'Fugitive Coal Dust', part of the 'National Coal Research Programme'. Measuring methods are given; inventory of storage-, transport- and shipping facilities and infrastructure are presented. Suggestions to limit the emission of coal dust are made. One of the main conclusions is that the dust of coal bears no risk for health, and nuisance is limited to an area of 1500 m round the emission source.

111 **Coal: can it be converted to environmentally acceptable liquid fuels.** Gray, R.H. (Battelle Pacific Northwest Laboratory, Richland, WA (USA)). *Journal of Coal Quality;* 6: No. 3, 82-88(Jul 1987).

Over the past decade a chemical and toxicological database was developed to aid engineers in the design of safe processes to convert coal to liquid fuels. Coal-derived liquids produced in different ways were screened for potential toxicological and environmental effects. Results showed that full-boiling-range coal liquids were generally more active than shale oil and petroleum crudes in toxicological test systems with active agents including polynuclear aromatic hydrocarbons (PAH), amino-PAH and phenolics. Hydrotreating and selective distillation restricted these compounds and their effects. Other process conditions and environmental factors also influenced the chemical characteristics and biological effects of coal-derived materials. Eliminating toxic input of coal liquids to ecological test systems resulted in partial system recovery. The data were used by developers to select process modifications and to develop occupational health and industrial hygiene practices.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 69, 71, 421

112 **(BMR—278) Geophysical abstracts and seismic profiles from the Central Eromanga Basin region, Eastern Australia.** Finlayson, D.M.; Leven, J.H.; Mathur, S.P.; Collins, C.D.N. (Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia)). 1987. 88p. Australian Government Publishing Services.

In 1980-82 for the first time, multiple-mode explosion seismic methods were applied to examine the structure and composition of a major intra-continental sedimentary basin (the Jurassic-Cretaceous Eromanga Basin), its infra-basins (the Adavale, Cooper and Galilee Basins), and the underlying lithosphere. In the central part of the Eromanga Basin, BMR recorded 1400 km of 20 s seismic reflection profiling data and 700 km of coincident, wide-angle reflection/refraction profiling data to provide an insight into the tectonic structure of the region. The results, to date, together with exploration industry data from a number of companies, have facilitated a regional analysis of sedimentary basin structures. This report brings together in a single publication the abstracts of 23 papers published or to be published in scientific journals; these papers have largely resulted from BMR seismic work in the Eromanga Basin. Also in this Report are the BMR seismic data and background information on the BMR research project. The details of the various interpretations are available in the full papers published in the journals referred to in this report.

113 (DOE/METC—87/6081, pp 5.C1.1-5.C1.19) **Identifying and correlating overburden strata which may require selective handling operations. I. Interpreting high quality geophysical logs.** Purdy, D.G.; Jenkins, O.; Jedlicka, J.J. (North American Coal Corp.). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The North American Coal Corporation conducted an investigation focusing on the application of classification, correlation, and calibration techniques for the purpose of interpreting the signatures of high quality geophysical logs. The objectives of this study were to: (1) evaluation the potential of using high quality geophysical logs to identify and correlate important chemical and physical properties of overburden materials; within a 5- to 10-year mining block; and (2) investigate methods to spatially characterize overburden properties important to the soil reconstruction process, using high quality geophysical logs as the final basis for identification and correlation. The data for the study were obtained from (1) digitized geophysical logs, (2) chemical and physical laboratory data of selected testing intervals, and (3) strata classification by depositional environment as interpreted by a professional geologist. The geophysical logs interpreted during this study included a natural gamma log, a density log, a resistivity log, and a caliper diameter log. The results of the statistical analyses of these data using analysis of variance (ANOVA), discriminant function analysis, and correlation analyses show that geophysical log signatures can be effectively grouped and interpreted. 7 references, 9 figures, 7 tables.

114 **(LA-UR—87-2885) Physical and chemical characteristics and development of the Changuinola peat deposit of northwestern Panama.** Cohen, A.D.; Raymond, R. Jr.; Thayer, G.; Ramirez, A. (Los Alamos National Lab., NM (USA); Instituto de Recursos Hidraulicos y Electrificacion, Panama City (Panama)). Aug 1987. Contract W-7405-ENG-36. 9p. (CONF-8708153—1). NTIS, PC A02. Order Number DE87014747/JAW.

From Wetlands/Peatlands '87; Edmonton, Canada (23 Aug 1987).

A peat deposit occupying over 80 square kilometers, and averaging 8 meters in thickness, was discovered on the Caribbean coast of northwestern Panama near the town of Changuinola. This deposit occurs inland (behind) the present beach-barrier shoreline. It is thickest in the center and thins toward all edges (as if domed). The surface vegetation in the central regions consists primarily of ombrotrophic plants (especially sedges, grasses, Sphagnum, Sagit

taria, and various scattered shrubs). Toward the edges, the deposit has a surface cover of more minerotrophic plants (such as swamp-forest trees, ferns, and palms). Petrographic/botanical analysis of the deposit with depth reveals the presence of five peat types (swamp-forest, sedge-grass-fern, Sagittaria et al., Nymphaea et al., and Rhizophora). Typically peats of the thick, central portions of the deposit are very low in ash and sulfur (less than 2% ash and 0.3% sulfur). Ash contents tend to increase abruptly at the base and more gradually toward the edges of the deposit and sulfur contents increasing gradually toward the ocean and bay. Vertical and lateral variations in botanical, chemical, and physical properties of this deposit can be related to factors that have controlled: (1) the surrounding rocks and water chemistry; (2) the source vegetation; and (3) the environments in which these source ingredients were deposited. 3 refs., 10 figs.

0120 Mining

REFER ALSO TO CITATION(S) 975

115 **(ACIRL-PR—87-2) Geotechnical methods for the evaluation of underground roadway conditions and support requirements.** Shepherd, J.; Rixon, L.K.; Walton, K.P.; Humphreys, D.R.; O'Beirne, T. (Australian Coal Industry Research Labs. Ltd., North Ryde). 1987. 96p. Australian Coal Industry Research Laboratories.

Observational techniques for determining field stresses in underground coal mines have been further developed and refined. These techniques utilise a whole range of mine roof fracture types to enable interpretation of stress directions, very often at a number of sites within a colliery. These techniques have been applied across 25 Eastern Australian collieries in seven coalfields and they have been found to be useful and generally applicable. Parts of 20 collieries showed roof deterioration caused by excess lateral stresses and therefore, the stress results are useful in relation to future mine layout planning. A case study of the role of lateral stresses was carried out at the now disused Rhondda No. 5 Mine at Ipswich (Qld). A geotechnical mapping system for collieries has been devised that assesses geological factors, stress direction, roof conditions and support conditions. Methods for borescope inspections of colliery roofs have been developed for the purpose of defining roof fracturing, stress directions and failure mechanisms. A timber prop strength testing rig has been designed, built and used for uniaxial prop tests, up to 40 t.

116 **(ACIRL-PR—87-3) Instability and support of coal mine ribs.** O'Beirne, T.; Shepherd, J.; Rixon, L.K.; Napper, A. (Australian Coal Industry Research Labs. Ltd., North Ryde). 1987. 130p. Australian Coal Industry Research Laboratories.

The stabilisation of coal ribs is seen as a key goal in the safe, efficient mining of thick seam friable coals or within zones of high strata pressures. Active rib stabilisation measures are being practised by an increasing number of operators with little or no technical knowledge on the mechanisms causing rib failure, or the remedial measures available. Research work undertaken by Australian Coal Industry Research Laboratories Ltd. (ACIRL) has delineated two distinctly different mechanisms causing rib failure. Various systems have also been developed for combating those mechanisms. Investigations have centred at operating mines, where the mechanisms were first studied; then trials of remedial measures were undertaken. Operators can use the results in this report to define the conditions in their operations and select the most efficient remedial measures. Comments on the use of rib supports for increasing the strength of pillars have been made.

117 **(ANL/ES—144-Suppl.1) Supplement to September 1984 final report: Development of a methane monitor meeting the Bureau of Mines' Intrinsically Safe Mine Monitoring System (ISMMS) requirements.** Zaromb, S.; Cohen, A.F.; Buttner, W.J.; Brunsman, B.; Imbrock, N.; Stetter, J.R.; Stamoudis, V.C. (Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001585/JAW.

The prime objective of this effort was to improve the sensitivity and stability of a previously developed electrochemical methane sensor, by optimizing the electrode catalysts and interface structure. The approach taken was to substitute thin nonporous Teflon sheets for the outer porous Teflon membranes that served as the electrode supports and as porous, selectively-permeable barriers between the nonaqueous liquid electrolyte and gas chambers adjacent to each electrode. The rationale for this approach was that partial pore flooding by the nonaqueous electrolyte, apparently responsible for observed sensitivity limitations, as well as slow losses of liquid by evaporation, might be avoided by using thin solid membranes similar to those successfully used in electrochemical oxygen sensors. Several sensor versions based on this approach were constructed and tested; none performed nearly as well as those made with porous Teflon membranes. With the solid membranes, the sensitivity to methane was only about 1/10th that obtained with the porous ones, and the response time was about five times as long (3-15 minutes). These results are attributed to a diffusion rate limitation combined with the much weaker reactivity of methane as compared with that of oxygen. To avoid the problems or limitations associated with either porous or thin nonporous Teflon membranes, it is recommended that the liquid electrolyte be either gelled or, preferably, be replaced by a suitable solid ionic conductor, so that the membranes could be dispensed with. 18 refs., 11 figs., 1 tab.

118 **(DOE/EIA—0125(87/2Q)) Coal distribution, January-June 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 30 Sep 1987. 99p. NTIS, PC A05/MF A01 - GPO; 1; GPO Dep. Order Number DE88001441/JAW.

Production and/or purchases of coal in the United States from January through June 1987 totaled 440 million short tons, or 1.7% less than in the first half of 1986. The coal distributed to domestic and foreign markets during the period amounted to 438 million short tons, a decline of 1.2% from the total a year earlier. During the period January through June 1987: domestic coal shipments to each consumer sector, except the electric utility sector, were lower than those in the first half of 1986; domestic coal shipments to electric utility plants were at a 5-year high level; coal exports were 12.4% below those 1 year earlier; and coal shipments via railroads and each type of water movement were lower, but those via truck and tramway/conveyor or slurry pipeline were higher than in the comparable period of 1986. 6 figs., 33 tabs.

119 (DOE/METC—87/6081, pp 2.B3.1-2B3.12) **Jewett mine dewatering: an overview.** Norris, M.J. (Northwestern Resources Co., Jewett, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The Jewett Mine is located near the town of Jewett in east central Texas. Mining depths range from 20 to 250 ft. Lignite produced at the Jewett Mine is from the upper portion of the Calvert Bluff Formation of the Wilcox Group. For studies conducted prior to mining, dewatering was evaluated in terms of slope stability. Dewatering would be utilized to prevent massive circular slip failures that could impact the dragline operation which is the primary overburden removal system. The role of dewatering has been expanded to control piping, materials flows, and in general, the amount of water in the pit. Dewatering at the Jewett Mine started with 30 wells and has expanded to approximately 150 wells in 2 areas. Results of the dewatering efforts are evident in the pit, scraper operations, and water levels in observation wells. Early studies provided a well field configuration for a given length of time. Logistical factors have affected the spacing. For a dewatering system to operate efficiently, many factors must be dealt with on a daily basis. 6 figures.

120 (DOE/METC—87/6081, pp 2.C2.1) **Utilization of low-grade coals in Asian developing countries.** Bailly, H.; Kimel, E.A. (Hagler, Bailly & Co., Inc., Washington, DC). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Most developing countries in Asia must spend a large portion of their foreign exchange to pay for imported fuels. Limitation on availability of capital and foreign exchange becomes a major constraint in successful implementation of their national development plans. Some countries have sizeable deposits of coal, generally of low-grade quality. To utilize these indigenous resources, technical, institutional, logistical and financial obstacles have to be resolved. The paper discusses briefly quality impact on the required technologies for coal mining, transportation and utilization. Government policies and legislation are discussed with respect to their impact on the economic and financial attractiveness of using local coals. Examples are given to illustrate the problems and potential solutions to promote low-grade coal utilization in Thailand, Philippines, Pakistan, South Korea and Indonesia.

121 (DOE/METC—87/6081, pp PS.3-PS.4) **In-situ mining of lignite with alkaline solutions.** Fischer, P.E.; Garza, H.A.; Liu, C.; Ouyang, W.O. (Texas Tech Univ., Lubbock). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The process proposed will consist in the injection of a stream of NaOH or $NaCO_3$ into a deep seam; this solution will contact the lignite and extract it at a low to moderate temperature level. The extract will be pumped to the surface and contacted with carbon dioxide to precipitate the lignite, and the clear liquid will be recycled to the formation to continue the extraction process. This paper presents the results for carbonate extraction of lignite. Two sets of experiments where performed. Small particles of Texas lignite were reacted with 500 ml of 0.5 and 0.25 normal solutions of $NaCO_3$ in a 2-liter batch reactor. The reaction times varied from 1 to 12 hours and temperature levels of 100, 130 and 160°C were used. Maximum conversion levels of 71% were found for these temperature-time levels, with higher conversion at the higher temperature level. The second set of experiments consisted of the reaction of these same mixtures at ambient temperature for periods up to 12 weeks with carbonate solutions of 0.1, 0.5 and 1.0N concentration. All of these experimental runs achieved a maximum extraction yield at 8 weeks, and then the soluble product decreased indicating the repolymerization of the extracted lignite into an insoluble form. The results of this research validate the concept of using alkaline solutions for the in-situ mining of lignite, even at very low temperatures. The results indicate also the existence of a repolymerization step, that can reduce yields. It is proposed that this step can be eliminated using dissolved oxygen in the alkaline solutions to control repolymerization and increase extraction yields.

122 **(ERP/CRL—87-48(TR)) Coal Research Laboratories. Annual progress report 1986-1987.** Haslett, G.A.; Stewart, D.B.; Theriault, Y. (comps.). (Canada Centre for Mineral and Energy Technology, Devon, Alberta. Coal Research Centre Devon). Apr 1987. 88p. CANMET, Devon, Alberta (Canada). Coal Research Laboratories.

The paper describes the activities of the Cape Breton, Surface Mining and Fuel Processing Research Laboratories in Canada during 1986-87. These included the organizing of international symposia and seminars. A review of laboratory programs in bitumen/oil characterisation provided opportunities for the development of research programs collaborating with industry. A major new geotechnical and processing program was initiated jointly with the Alberta Oil Sands Technical Research Association at their underground test facility.

123 (EUR—10811, pp 7-23) **Coal winning - a system analysis and ways towards improved economics.** Schucht, K. (Bergbau AG, Westfalen (Germany, F.R.)). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

Remarkable rationalisation successes have been achieved over the last decades in coal winning within the European Community. For future developments the following key areas may be highlighted: In face technology the equipment deployment exhibits a high level of development. Further technical progress would require immense outlay. Thought should be given to entirely new methods and techniques in winning, for example, to breaking up the fossilised face system; T-junctions as sensitive points deserve special considerations not least because of their accident-proneness. Here resides a substantial rationalisation potential; greater use of stowing and a reduced proportion of dirt in the mined coal can make valuable contributions to improving the environment. This will also reduce strata settling and consequently internal and surface mining subsidence; and the automation of part-operations in winning and an optimal monitoring with modern information and communication systems will lead to higher utilization rates of the extremely costly face equipment and so to better profitability. Since successes here can be expected in the short term, process innovation should be a particular priority in our work. But in many instances we lack sensors and actuators suitable for mining conditions to execute automation, control and monitoring. The development of these and their integration into the winning equipment is also an urgent task. The development key points indicated here are extremely important for all the coal mines of the European Community. Advances here can only be achieved in joint and coordinated work. The committees of the Commission of the European Communities are called upon to do this.

124 (EUR—10811, pp 26-38) **Extraction by longwall faces in steep seams.** Geraud, C. (Charbonnages de France, Freyming-Merlebach). 1987. European Community Inforamtion Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

About 54% of the coal produced by the Lorraine coalfield is extracted from deposits inclined at more than 30 degrees. Original methods for mechanized winning to the rise have been developed in conjunction with hydraulic stowing. With results gradually levelling off, it has proved necessary to investigate different techniques and, notably by extrapolation, to progress towards longwall winning methods derived from those employed under level-seam conditions. In-semi-steep seams (35 degrees) it has been possible to develop uniform, high-performance equipment (winning machines capable of cutting speeds of 6m/min and using chainless haulage systems developing haulage efforts of 600 kN, face conveyors fitted with anti-drift flanges, powered supports equipped with devices to maintain alignment on the dip) capable of achieving face outputs of 2500 t/day and more. In steep seams (60 degrees) a totally new method was developed involving a remote-controlled shearer working in conjunction with a support system which has been adapted to the dip conditions (the support units are linked together to form groups of three and are not connected to the AFC) with goaf stowing by means of dry sand with the clay removed. Because of the seam dip, these methods have proved vulnerable under difficult mining conditions. Equipment has still to be developed which will permit effective strata control under all circumstances; in view of the quality of the reserves which exist in steep seams, the introduction of such equipment has become a priority.

125 (EUR—10811, pp 39-46) **Advanced technology face.** Massey, C.T. (British Coal, Stanhope Bretby (United Kingdom)). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

In response to a recognition in the 1970's by the U.K. coal industry that face production and productivity should improve, the National Coal Board embarked on a programme which became known as Advanced Technology Mining. The aim was to integrate new and proven technology onto coal faces and so to concentrate effort into the development of remote application techniques, the introduction of heavy duty face equipment, the optimisation of seam extraction and the improvement of face safety records. Since then, and in close collaboration with the industry's coal face equipment manufacturers, development has continued into improved power loaders, powered supports and face conveyors, not only for applications into the thicker seams, but in an attempt to optimise

production from all seam sections. A natural progression was to apply computer technology to coal face operations in an attempt to improve overall reliability, to reduce the size of coal face teams and so increase productivity. The National Coal Board's aim has always been to introduce Advanced Technology Mining features wherever it was clear that their application would improve production and productivity. The natural next step was to continue this philosophy into new mines, of which Selby is a prime example and where those results which the Mining Engineer was dreaming of in the 1970's are now being achieved.

126 (EUR—10811, pp 66-76) **5000-volt supply for face equipment.** Fischer, B. (Charbonnages de France, Freyming-Merlebach). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

The increase in mechanisation in longwall mining districts has imposed the need for the motors installed to have ever higher power ratings. Torque loss at the moment of start-up and of power pick-up have made it necessary to raise the voltage supplied in high-production workings. The choice has fallen on 5000 V, a voltage already widely used in underground mining right up to the actual face workings. 5 kV electrical equipment for AFCs introduced in July 1983 has given very satisfactory results: start-up difficulties and AFC jamming have disappeared entirely, nor has any incident been reported which could be attributed to the voltage increase. To complete these 5 kV installations the following will be undergoing trials: - a 5 kV plough installation at the beginning of 1986 - a 5 kV shearer at the beginning of 1987. 2 refs.

127 (EUR—10811, pp 77-86) **Power supply, control and monitoring of coal winning districts using modern process control techniques.** Kugler, U.H. (Ruhrkohle AG (Germany, F.R.)). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

The dramatic development of information technology and process techniques is having a growing influence on mining as well. The training of personnel, the systematic incorporation and the elements of process control techniques are all described. Five examples - for which Osterfeld colliery was the trailblazer in coal winning - are used to illustrate the present state of development and the successes in Ruhr mining. They are: district control rooms, automation of the coal plough, automation and monitoring of shield supports, regulation and monitoring of centralised refrigeration plants and the 10 kV power supply. Inspired by visions of the future we are engaged in the solid day-to-day work of opening up and exploiting the opportunities offered to us by process technology. 5 refs.

128 (EUR—10811, pp 87-100) **EW remote control and data transmission systems for coal winning machines.** Boutonnat, M.; Noel, M. (Charbonnages de France. Centre d'Etudes et Recherches). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

In 1979, it was decided at Cerchar to research a new generation of remote control systems with the aim of developing equipment that would be effective, reliable and capable of providing, in particular, control of double-drum shearers by two persons, i.e. with two transmitters. The research work culminated in a numerical coding remote control system called TELSAFE-DV. Modular and expandable, this equipment will adapt to every type of machine. The TELSAFE-DV with two transmitters has been manufactured for SIRUS, PANDA and DTF shearers. It has also been adapted to control loader-transporter vehicles (LHDs). Another type of equipment, called the TELSAFE-CA, was devised for the remote control and monitoring of mobile mine machines, transmission being effected via the power feed cable. Machine guidance is carried out from a fixed control console which can be located underground or on the surface-underground link being by telephone line. The first installation was designed for the remote control of a shearer working to the dip in a steep seam. A second shearer has been equipped for different phases of automation. TELESAFE-CA will represent a valuable tool in the monitoring of the functioning and health of shearers, while preparing the machine for automation in due course. 2 refs.

129 (EUR—10811, pp 101-115) **Monitoring and automation for the coalface.** Barham, D.K.; Cutts, A. (British Coal, Stanhope Bretby (United Kingdom)). 1987. European Community Information Service, 2100 M. Street, N.W., Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

The majority of coalfaces in the United Kingdom are constrained by geology, seam conditions and the infrastructure associated with long-established mines from realising their productive capacity. Monitoring and control systems are making a contribution to improving the efficiency of the longwall system within the imposed constraints. Lost time due to machine breakdowns has been reduced by routine condition monitoring of equipment and, by monitoring the total system of face operations, it has been possible to expose the problem areas where system design and organisation can improve the face performance. Face conditions and extraction have been improved by automatic horizon control, roof control and face advance maximised by control of the face line. These monitoring and control systems have been tested and evaluated in many coalfields and many of them are in an advanced stage of application. North Derbyshire Area has pioneered many aspects of these developments and some experiences are described in the paper. 2 refs.

130 (EUR—10811, pp 118-131) **Installation and withdrawal of face equipment in the Provence coalfield.** Verstraete, M. (Provence Coalfield (France)). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

For several years the Provence Coalfield has extracted one very thick coal seam (2.50 to 3 meters) by introducing mechanised longwall techniques. This revolutionary change was accompanied from 1974 onwards by a significant step forward in transport with the introduction of rubber-tyred vehicles. These have made it possible to keep down the costs of underground services in the mine and have given great flexibility to winning methods. This flexibility is used to the full in the installation and dismantling of faces. For these operations the key problem is often one of speed and of transport capacity (2000 tonnes of equipment to shift for a 200 m face). The Provence Coalfield has always striven to keep the time taken by dismantling to a minimum so as to avoid rockbursts, so disastrous for powered supports and to limit production losses due to the working being halted since the work is carried out by the men of the district themselves. The transfer usually lasts 6 to 10 days but since the work makes use of the weekend the production stoppage is actually one of 4 to 6 days. This paper presents the techniques and operating modes employed, in dismantling in particular, and highlights possible improvements.

131 (EUR—10811, pp 132-159) **Installation of face equipment and face end techniques - present status and trends of development.** Lehmann, G. (Ruhrkohle AG (Germany, F.R.)). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

After years of stagnation, new developments have recently taken place both in face installation and in face-end technology which will provide the basis for further shift savings and hence im-

proved productivity in the Ruhr mining industry. The increased mechanisation of in-seam headings over the past three years is a prime example of these developments which will continue to gather pace over the next few years. At the same time, observations and investigations have led to new insights into the optimum location of headings and their cross-sectional forms which will result in savings in costs and man shift. Face installation has been made easier thanks to improvements in procedures, new equipment that is easier to assemble, new transport facilities tailored to individual requirements and favourable heading cross-sections, even though special arrangements such as the development of faces from gate roads or the use of trackless means of transport will continue to be used as and when appropriate. In the field of face-end technology, countless solutions to individual problem areas have been found, both support-related and mechanical, which can already be employed to increase productivity still further. Further work is required on these developments, however, in order to make more use of their results than has so far been the case and to overcome the retarding effects that this area has on overall development work. 29 refs.

132 (EUR—10811, pp 160-176) **Face salvage employing free steered vehicles and strata support with roof bolts.** Hodgkinson, D.R. (British Coal, London (United Kingdom)). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

Face salvage operations using free steered vehicles (F.S.V.), allied to roof bolts as the primary support on the face side, have been used on numerous longwall installations in the United States. This method of salvage reduces the number of men involved both in preparation and recovery. When each powered support is lowered the operator is positioned some distance away, the support being lowered remotely. Also the F.S.V. driver's cab is positioned underneath the chock canopies when traversing the face. In June 1984, a small team from British Coal's Western Area studied such a recovery operation. It was felt that a suitable site should be found in the Area to apply similar techniques and that substantial advantages could arise in both safety and efficiency.

133 (EUR—10811, pp 177-194) **New techniques at face ends.** Syddall, N.G. (British Coal, London (United Kingdom)). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

The paper examines some of the measures taken at the face ends of retreat faces in the United Kingdom which are designed to minimise the effects of poor gate conditions on production. It then examines the various methods of roadway formation, gate side packing and the erection of the permanent supports in the gates of advancing faces. It draws attention to the interaction between these activities and face production and outlines measures that could reduce such delays by reintroduction of flexibility into the design of our face ends.

134 (EUR—10811, pp 195-205) **Evolution of face end mechanization in the Campine collieries.** Legrand, J.; Resseler, R. (Zolder Colliery (Belgium)). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

At Zolder Colliery most of the roadways are driven behind the face due to the high pressure of the roof and the deformation of the adjacent strata. Since 1967 various machines have been used for cutting the stableholes. All of these machines were derived from each other. This paper describes the latest machine versions for the mechanised drivage of in-seam tail and main gates. Various machines were installed on trial for the integral drivage of the roadways of a panel. Due to these trials two machines were selected for further development. The first one of these two machines is used for driving the roadways in front of the face. The second one is adapted to the integral drivage of the tail gate in line with the face. Experience has shown that due to the condition of the adjacent strata in this Campine deposit roadway drivage behind or in line with the face is the only suitable method. The machines which were originally developed for use at the face ends have found other applications which are described in short. 1 ref.

135 **(NERDDP-CS—86-17) Study of advanced electronic information and control systems for coal mining.** (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1986. vp. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601 Australia.

The overall objective of this study is to assess the current and future needs of the Australian coal mining industry for advanced electronic monitoring/control equipment and computer based management/mining information and control systems. The study encompasses a comprehensive 'state-of-the-art' review of technology available both in Australia and overseas, particularly UK, France, Federal Republic of Germany and USA. The review evaluates the relevant technologies for both open cut and underground in Australia.

136 **(NP—7770282) Exploration of mining sections in underground coal mines by means of horizontal drill holes of great length. Final report.** Palm, H.; Marx, C.; Hegemann, H. (Ruhrkohle A.G., Essen (Germany, F.R.); Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). Feb 1987. 105p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87770282/JAW.

The project was aimed at the development of a drilling method applying wire-line technology for reliably achieving underground horizontal drill hole lengths of at least 1 000 metres under adverse geological conditions. Since with difficult geological environment the drill hole walls tend to instability and cave in due to the lack of in-hole stabilizing hydraulic pressure, a pressure lock had first of all to be built and tested at several experimental drillings underground. Significant malfunction was encountered under operational conditions requiring substantial re-design until full operability was proved. The intended stabilization inside of the drill hole could not be achieved. None of the test drillings could be executed without problems, to the contrary all of them had to be stopped prematurely. The experiments led to the insight of new problems with regard to drilling technology which so far could not eventually be defined. With 18 refs., 7 tabs., 41 figs.

137 **(NP—7770311) Development and field testing of face-end supports for supply gates headed in line with the face.** Tekathen, U.; Samse, V. (Ruhrkohle A.G., Essen (Germany, F.R.)). Nov 1986. 19p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770311/JAW.

This research project aims at replacing individual prop support by powered support which needs to be matched to the particular support technological demands of this zone. The partial project A comprises development and field testing of road-side support. Six units with extensible forward- and rear-cantilever canopies (75 cm centers) were developed in cooperation with Gewerkschaft Eisenhuette Westfalia, and field-tested in 4 faces. Accident rate development became positive. With respect to support criteria, some essential demands were not met yet. With 2 tabs., 5 figs.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 49, 120, 175

138 **(AD-P—005479/1/XAB) Analogy and differences between coal-slurry transport systems and hydraulic dredging.** Verback, P.R.; Noordt, V.V. (Industrieele Handelscombinatie Holland N.V., Rotterdam (Netherlands)). Mar 1987. 9p. NTIS, PC A02/MF A01.

This article is from United States - The Netherlands Meeting on Dredging and Related Technology (3rd) Held in Charleston, South Carolina on 10-14 September 1984, AD-A182 670, 62-70.

The oil crises in 1973 and 1978 caused many countries to initiate a diversification policy for power-generating fuels to reduce their dependence on oil. A renewed interest in the utilization of coal appeared and, around 1980, the prospects for the future use of coal were very optimistic. Although this optimism has since been considerably reduced, steam coal consumption is expected to rise steadily and thus the export and import quantities of coal. As a result, the transshipment and further transport capacities are expanding. One possible method of transporting coal is by pipeline, where a differentiation should be made between long-distance fine-coal transport and short-distance coarse-coal transport. Slurry handling of coal has many similarities, but also substantial differences, when compared with the hydraulic handling of solids in the dredging industry. In this paper, long-distance fine coal slurry and short-distance coarse-coal slurry transport are discussed as well as the similarities and differences when compared with hydraulic transportation of solids in the dredging industry. As a coarse-coal system, a slurry unloading terminal is discussed in more detail.

139 **(AD-P—005504/6/XAB) Simulation study of the navigability of the main ship channel in Mobile Harbor.** O'Hara, J.M.; D'Amico, S.D. (National Maritime Research Center, Kings Point, NY (USA). Computer Aided Operations Research Facility). Mar 1987. 5p. NTIS, PC A02/MF A01.

This article is from United States - The Netherlands Meeting on Dredging and Related Technology (3rd) Held in Charleston, South Carolina on 10-14 September 1984, AD-A182 670, 287-291.

The Port of Mobile is one of the major US coal ports. Transit into and out of the port by large vessels is made possible by an approximately 30-nm-long ship channel extending from the Gulf of Mexico, through Mobile Bay, and into the Mobile River. At present, the controlling channel depth is 40 ft and the channel bottom width is 400 ft throughout most of the channel's length. This controlling depth prohibits many deeper draft vessels of the 50,000 plus DWT class from loading to full capacity. light loading of larger vessels makes the movement of cargo more expensive, thus restricting the use of the port by these vessels and lowering the port's efficiency. In response to this problem, the Mobile District of the US Army Corps of Engineers and the Alabama State Docks Department have proposed a harbor design plan that would enable the Port of Mobile to better accommodate deep-draft bulk carriers and better utilize their deadweight capacity. The three central elements of the plan include: (1) deepening of the ship channel from 40 to 55 ft, (2) construction of a turning basin across from the main coal terminal at McDuffie Island, and (3) construction of an anchorage area south of the turning basin.

140 (DOE/METC—87/6077, pp 369-377) **Fluidic fuel feed system.** Drzewiecki, T.M.; Holmes, A.B. (Defense Research Technologies, Inc., Rockville, MD). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

Fluidics is the technology which employs various fluid dynamic effects, such as boundary layer wall attachment (Coanda effect), fluid stream interactions, and vortex throttling to perform functions normally accomplished with standard moving-part-fluid power components such as: valves, pressure amplifiers, and fluid logic components. Fluidics technology was first introduced by the Diamond Ordnance Fuze Laboratories (now Harry Diamond Laboratories) in 1959. The technology is now employed in numerous aerospace, medical, military, and industrial applications where corrosive, erosive fluids are controlled and where reliability is required in particularly harsh operating environments. The objective of this program is to design, fabricate and test a no-moving parts fluidic fuel control system for injecting a coal slurry into a diesel engine. Main emphasis is on improving the operating life of coal slurry fuel controls and injector hardware. The purpose of the initial part of this project is to determine if fluidic control techniques can be used effectively in coal-fueled diesel engines. Preliminary results are discussed. 5 references, 9 figures.

141 (DOE/METC—87/6077, pp 398-403) **Combustion bomb studies - a comparison of an accumulator-based injection system with a positive displacement-based system for coal-fueled diesel engine applications.** Leonard, G. (General Electric Co., Schenectady, NY). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-85MC22181.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of this work was to determine if an accumulator-based fuel injection system would out perform a positive displacement-based system for coal-fueled diesel engine applications. The high-injection pressure obtainable early in the injection cycle with the accumulator injector should lead to a significant improvement in the CWM's ignition characteristics. The accumulator-based injection system is also capable of delivering fuel to the diesel combustion chamber with a high-injection pressure over a wide range of engine operating conditions. This flexibility should improve part power combustion with CWMs. Performance test results are given. 4 references, 7 figures, 1 table.

142 (DOE/METC—87/6081, pp 2.B2.1-2.B2.12) **Replacement of two material control systems with a new centralized color graphics system.** Braley, D.B. (Utility Fuels, Inc., Houston, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Utility Fuels, Inc. (UFI) owns and operates coal handling facilities that service Units 5, 6, 7, and 8 at Houston Lighting & Power's W.A. Parish Electric Generating Station. Nine million tons of coal is transported annually by unit train from mines in Montana and Wyoming and is stacked out over Reclaim Feeders that deliver the coal conveyor belts to the unit silos. The reclaim system feeding Units 5 and 6 (660 MW each) is designated as Phase I while the second system, Phase II, supplies Units 7 and 8 (560 MW each). A Mimic Coal Board was located in each of HL & P's Phase I and Phase II control centers for monitoring and controlling the Phase I and Phase II Reclaim Systems. In late 1985, UFI decided to replace the Phase I system and to consolidate the Phase I and II Reclaim Control Systems in a new building. The project consisted of replacing the control system on Phase I with Modicon Programmable Logic Controllers and Remote Input/Output Modules similar to that existing in Phase II. Phase I and Phase II Mimic Control boards were replaced with a computerized CRT/Color Graphics Operators Console. In December, 1986, Phase I and II were operational and training was completed. Operations was able to move out of HL & P's two control rooms into a centralized, state-of-the-art Operations Control Center. The early planning, designing, and implementation of this system, and its description, is the subject of this paper. The equipment was installed and tested without disruption of UFI's ability to deliver coal. From the time a Project Team was established in January, 1986, to the turning over to Operations in January, 1987, UFI never once failed to meet its coal delivery requirements to HL & P. 3 figures.

143 (DOE/METC—87/6081, pp PS.1) **Wet fuel handling - a program to minimize pluggage.** Bennett, R.; Fogel, W.; Aloia, P. (GUS, Inc., Dallas, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Assuring the free flow of wet fuel through transfer points, hoppers and downcomers has been a problem for years. It has been proven that fuel can be enhanced significantly by application of certain surfactant or polymer formulations. Additionally, lime has been shown to be effective in several applications. The current laboratory method of fuel flow evaluation involves a rotational shear tester to quantify fuel quality. This technique minimizes sample preparation and test time. This allows results to be obtained in time to anticipate fuel handling problems by testing in the field at the plant site. While moisture content has a major impact on fuel flow, it has also been found that the finer mesh fractions of fuel contain greater percentages of silica than the bulk fuel. This indication of ash or clay is another parameter which can correlate with fuel

pluggage. Extensive evaluation with a portable x-ray fluorescence analyzer has shown that this method can be used to monitor silica and ash on a real time basis. The current on-site wet fuel monitoring program entails continuous monitoring with periodic evaluation of fuel for moisture content, silica content, and shear test values. An extensive base can be established for each site, relating fuel quality to pluggage problems and factors determined for the use of chemicals and the feed rates required. By monitoring the fuel this closely, the number of pluggage incidents, their duration, the cost of chemical treatment, and lost generation can all be minimized.

144 (DOE/PC/80524—T8) **Pipe and bend erosion by pneumatic transport of solids at high temperature: Quarterly report, March-June 1987.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1987. Contract FG22-85PC80524. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001345/JAW.

The test series using slag as erodent have begun. Special attention is given to the effect of temperature on the erosion rates. Three tests runs have been completed. 2 figs., 1 tab.

0140 Combustion

REFER ALSO TO CITATION(S) 3, 5, 6, 9, 10, 48, 50, 51, 52, 53, 54, 55, 74, 75, 79, 80, 81, 83, 84, 96, 120, 141, 195, 608, 609, 610, 624, 625, 626, 627, 1108, 1138, 1140, 1142, 1143, 1144

145 (ANL/CNSV-TM—173, pp 56-65) **Fluidized-bed boilers: an emerging alternative technology.** Vander Molen, R.H. (Combustion Power Co., Menlo Park, CA). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

Fluidized bed boilers are becoming well established for most industrial applications. They are only now emerging for application in resource recovery plants. The heterogeneous nature of MSW and the concern over acid gas and other emissions, are areas where the FBB has natural advantages over more conventional combustion systems. In addition, the FBB has the capability to obtain more steam per pound of fired fuel through its high overall efficiency. Fluidized-bed boilers are well enough developed to be considered as viable candidates for resource recovery.

146 (ANL/FE—87-4) **Ultrasonic techniques for coal-slurry flow and viscosity measurement.** Sheen, S.H.; Raptis, A.C.; Lee, S.; Simpson, T.; Bobis, J.P. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000450/JAW.

This report summarizes the development of an active ultrasonic cross-correlation flowmeter for coal slurry flows and the evaluation of ultrasonic techniques for coal slurry viscosity measurement. The flowmeter development comprises evaluation of design parameter, development of signal-conditioning electronics and an IBM-PC/AT-based signal processing system, and results of SRC-I pilot plant tests. The developed flowmeter, with a standoff arrangement, can be used in a high-temperature hostile environment for measuring solid-liquid mixed-phase flows in either a laminar or turbulent flow regime. The accuracy of the flow measurement and limitations of the flowmeter are discussed. The meter response time is typically around 40 s. Approaches for improving this response time are also discussed. Potential ultrasonic techniques for coal slurry viscosity measurement are examined theoretically. Sound wave attenuation in fluids is measured and related to the apparent viscosity of the fluid. 12 refs., 23 figs., 3 tabs.

147 (CONF-8610247—, pp 31-47) **Clean coal projects implementation.** Wilson, J.S.; Strakey, J.P. (Morgantown Energy Technology Center, WV). 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

The Clean Coal Technology projects were selected by the US Department of Energy (DOE) as a result of a competitive Program Opportunity Notice issued in February, 1986. The projects have been assigned to the Energy Technology Centers for negotiation and monitored according to the lead assignments of each center. Five projects have been assigned to the Morgantown Energy Technology Center (METC) and four projects to the Pittsburgh Energy Technology Center (PETC) in accordance with the lead responsibilities of each center. These projects will be negotiated over the next several months, and, assuming successful agreements are reached, will be under way by April 1987. A listing of the projects selected is shown. This paper describes the individual projects and the management approach that the Fossil Energy Office will apply to all projects. The technologies involved include: fluidized-bed combustion, coal gasification for power generation, underground coal gasification, direct iron ore reduction, limestone injection, slagging combustor with sorbent injection, coal-oil coprocessing.

148 (CONF-8610247—, pp 61-66) **Coal fuels for gas turbines: the industrial response to the federal program.** Carroll, P.A. 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

Solar Turbines, Inc., in cooperation with the US DOE, is developing a coal-fired gas turbine. This paper discusses the impact such a gas turbine could have on coal consumption, the cleaning such a fuel would require, and applications for the technology. The gas turbine system is briefly described. 2 figures.

149 (CONF-8610247—, pp 67-76) **TRW's combustion business.** Gerding, R.B. 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

Description and performance are discussed for the TRW Slagging Combustion system whose potential near-term applications include the retrofit of oil- and coal-fired boilers, process heaters, kilns, and new coal-fired equipment. It burns a variety of pulverized coals and coal-water mixtures. An industrial scale demonstration project is described. A 40 MMBtu/hr slagging combustor was retrofitted to a 30,000 lbs/hr boiler. The combustor is halfway through its 4000-hour test. 5 figures.

150 (CONF-8610247—, pp 81-86) **Coal-fired electric generating capacity for the 1990s.** Preston, G.T. (Electric Power Research Institute, Palo Alto, CA). 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

The paper discusses the development of thermal efficiency of coal-fired power plants from 1880 to the present. Thermal efficiency peaked in the mid-1960s with combined-cycle power generation. Because of the sharp rise in per kilowatt cost of new capacity additions, utilities are improving availability, extending life of existing plants, and using conservation and better management. To meet new capacity for the future, this paper suggests commercially available and near-commercial technology that utilities should consider: atmospheric or pressurized fluidized-bed combustion and coal gasification/combined-cycle generation. 2 figures, 1 table.

151 (CONF-8610247—, pp 109-146) **Fluidized combustion: past, present, and future.** Ehrlich, S. (Electric Power Research Institute, Palo Alto, CA). 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

The forecasts made 16 years ago by Douglas Elliot and John Bishop about the future of fluidized-bed combustion technology are reviewed. The technology today is then discussed: 1. mechanical features - air distribution, startup systems, control systems, improved heat transfer, coal feed; 2. process issues - fouling, corrosion, and erosion, low-grade fuels, thermal inertia, sulfur retention, nitric oxides, particulate control; 3. serious applications - conversion of existing boilers, replacing existing boilers, municipal waste fuels. Also discussed are high heat release rates, combustion efficiency, natural circulation boilers, and circulating fluidized beds. The

author also adds his own predictions of the future of this technology. 72 references, 11 figures, 7 tables.

152 (CONF-8610247—, pp 147-162) **Coal utilization by existing generating capacity.** Preston, G.T. (Electric Power Research Institute, Palo Alto, CA). 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

This presentation summarizes the state of technology, costs and the technical and institutional issues associated with coal cleaning and utility boiler reliability; combustion modifications for control of NOx emissions; and coal water slurry firing in oil-design boilers. The paper considers physical coal cleaning, dry sorbent injection, chemical coal cleaning, flue gas wet scrubbing, atmospheric and pressurized fluidized-bed combustion, coal gasifaction, and post combustion NOx control. 6 figures.

153 (CONF-8610247—, pp 163-188) **Atmospheric fluidized bed combustion: international perspectives and prospects.** Baker, A. (IEA Coal Research, London, England). 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

Fluidized bed combustion for industrial steam raising has had a somewhat checkered history. Some twenty years ago prospects seemed excellent; advantages were seen to lie in superior combustion of lower grade (cheaper) coals, lower plant investment costs because of superior heat transfer enabling compact designs, and the ability to control emissions of sulfur and NO/sub x/ pollutants. Then development problems, unforeseen or unavoided, made the performance of early plants disappointing and the pace of installations, and the enthusiasm, seemed to falter. However, much has happened in the last 5 years or so, with many new FBC designs, and with solutions to, or ways of living with, difficulties. There are now many installations and some have the long running time experience that is essential for effective development and for confidence in performance. This paper seeks to summarize the present position, suggests points of difficulty which remain and what the prospects are. It covers the use of atmospheric fluidized bed combustion (AFBC), in its various forms, for steam generation in industry and smaller scale power generation. It does not discuss pressurized fluidized bed combustion for power generation which, though an attractive prospect, is an an earlier stage of development, perhaps 10 years or so behind AFBC. 4 references, 12 figures, 1 table.

154 (CONF-8610247—, pp 219-224) **Illinois clean coal technology programs.** Moreland, T. 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

Illinois decided over a decade ago to focus major resources on protecting the coal industry. Since that time, a comprehensive program of coal development has grown to encompass coal research, technology demonstration, incentives for the commercial use of clean coal technologies, and initiatives for marketing and exporting coal. This paper describes eight programs sponsored in part by Illinois demonstrating the technology of atmospheric fluidized-bed combustion with and without cogeneration, circulating fluidized-bed combustion, also with and without cogeneration, low Btu coal gasification, wet flue gas desulfurization with and without regeneration of adsorbents.

155 (CONF-8610247—, pp 225-244) **Review of an industrial coal-fired boiler project.** Grahek, R.J.; Farbstein, S.B. (BFGoodrich Co., Henry, IL). 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

In October, 1985 a Pyroflow circulating fluidized bed combustion (FBC) boiler was put into service at the BFGoodrich Plant in Henry, Illinois. The designed capacity of this boiler is 125,000 pounds per hour of 400 psig saturated steam. The boiler was constructed by the Pyropower Corporation and was partially funded by the State of Illinois, Department of Energy and natural Resources through its Coal Bond Fund. This paper describes the factors and analyses used to evaluate the technology and justify the project. Also included is a description of the boiler system along with a summary of operating experience since start-up.

156 (DOE/MC/21069—2376) **Characterization of solids mixing in a laboratory-scale fluidized bed: Final report.** Macek, A.; Amin, N.D. (National Bureau of Standards, Washington, DC (USA). Center for Chemical Engineering). Dec 1986. Contract AI21-84MC21069. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87006501/JAW.

The objective of the present study was the demonstration of the capability of a novel optical measurement technique to characterize the mixing of solids in a laboratory-scale fluidized bed at fluidized-bed combustion temperatures. This report contains: (1) description of the measurement technique; (2) results of minimum fluidization velocity measurements as functions of temperature and particle size; (3) experimental mixing results in terms of two parameters defined for the purpose of solids mixing characterization; and (4) comparison of experimental data with the results obtained from a simple one-dimensional dispersion model. The technical basis for the experimental study was the recent development of an optical diagnostic technique which allows one to distinguish a burning particle from inert particles at an arbitrarily chosen location in the interior of a high-temperature fluidized bed. In the present application of this technique, continuous radiometric records were obtained simultaneously from optical probes placed at two locations in a fluidized bed, 15 cm in diameter. The basic concept was a correlation of arrival times and frequencies, registered by the probes, of fuel particles, injected at various distances from the probes. A general conclusion from both the experimental and modelling results is that at fluidization velocities exceeding about 2.3 U/sub mf/ the fuel and the inert bed particles are well mixed. It is also concluded that the solids dispersion coefficients for larger fluidized bed combustors should be as high as, or higher than, those reported in the present study. 24 refs., 6 figs., 10 tabs.

157 (DOE/MC/21284—2318) **Gas turbine component screening program fuel flexible combustor: Final report.** LeCren, R.T.; Cowell, L.H.; Wen, C.S.; White, D.J. (Solar Turbines, Inc., San Diego, CA (USA)). Feb 1987. Contract AC21-84MC21284. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87006519/JAW.

An advanced two stage slagging, high-pressure gas turbine combustion system for burning coal-water mixtures was designed, built and tested. The combustor was 1/10 scale in volume of that required for the Solar Centaur gas turbine engine. The combustor featured a rich primary zone with hot refractory walls. Molten slag separation in the primary zone was accomplished inertially using a form of jet impaction. The secondary zone was operated in the lean mode and also incorporated hot refractory walls. The rich-lean approach was chosen to minimize the production of NO/sub x/ by both thermal conversion of atmospheric nitrogen and conversion of fuel bound nitrogen. The purpose of this program was to move into the next phase of an overall program to demonstrate the operation of a gas turbine engine burning coal fuel. The data and experience gained from a previous contract (AC21-83MC20229) were utilized in the design and testing of this combustor. The major differences in this combustor compared to the previous one are: a shorter, larger diameter primary zone to reduce surface to volume ratio, an annular gap slag pit to improve slag removal, an improved fuel injector, elimination of air-cooled walls in the secondary and increased size (1/10 scale instead of 1/12).

158 (DOE/MC/23167—2400) **Advanced coal-fueled gas turbine systems: Semi-annual report for the period January-June 1987.** (Westinghouse Electric Corp., Orlando, FL (USA). Generation Technology Systems Div.). Jul 1987. Contract AC21-86MC23167. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87006515/JAW.

The Department of Energy initiated the Advanced Coal-Fueled Gas Turbine Systems Program as an R and D effort to establish the technology base for the commercial application of direct coal-fired gas turbines. Westinghouse Electric Corporation began work on this program on July 24, 1986. During the 6-month reporting period described here, effort has concentrated on the Subscale

Combustion System. This is the second semiannual technical progress report for the program. After a brief introduction, a program overview is presented. Following this, accomplishments in the above task are discussed.

159 (DOE/MC/23249—2397) **Kinetic behavior of solid particles in fluidized beds: Solid particle kinetic forces: Progress report for the period January 1-March 31, 1987.** Kono, Hisashi O.; Huang, Ching-Chung. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). Apr 1987. Contract AC21-86MC23249. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014005/JAW.

A tracer particle method has been developed and applied to investigate the effects of the parameters such as superficial gas velocity, fluidized particle size, and bed diameter on the kinetic forces prevailing in fluidized beds. The kinetic forces of fluidized particles become large with the increase of the fluidizing gas velocity in both bubbling and slugging flow regimes. The kinetic forces of fluidized particles also increase with larger sizes of fluidized particles. The bed diameter does not significantly affect the kinetic forces prevailing in fluidized beds if the bed height remains constant. The applicability of the Piezotron sensor for the measurement of kinetic forces was also investigated. The interpretation of the Piezotron sensor signal was hampered by the vibration of the fluidized column. However, the Piezotron sensor can still be used to evaluate the kinetic force distribution in the fluidized bed by inserting the sensor from the top of the fluidized bed (independent of column). The advantage of the Piezotron sensor is that a kinetic force distribution in the bed may be directly obtained. 2 refs., 10 figs.

160 (DOE/METC—87/0238) **Fluidized-bed combustion: Technical status report.** (USDOE Morgantown Energy Technology Center, WV). Oct 1985. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87006484/JAW.

The goal of METC's FBC program is to establish, by the early 1990s, an engineering technology base that the utility, industrial, commercial, and residential sectors can use to build and operate coal-fired FBC systems. These systems would generate process steam, direct and indirect heat, and electric power from coals of all ranks and sulfur content in an economical and environmentally-acceptable manner. First-generation AFBC technology is already considered commercial and a number of US boiler manufacturers are offering commercial units. However, there are greater opportunities for improvement in economics, performance, and reliability. In order to resolve the remaining technical issues and to broaden the market sector served by AFBC, the DOE is pursuing advanced concepts. This second-generation AFBC technology is directed toward small industrial, commercial, and residential applications. Penetration of these potential markets will require 20- to 30-percent reduction in capital and operating costs over first-generation technology, significant improvements in performance and reliability, and compliance with existing and proposed New Source Performance Standards for environmental emissions. PFBC technology, on the other hand, is less developed and is not yet commercial. Sufficient R & D has been carried out, however, to establish its advantages and to demonstrate the viability of the technology for displacing imported oil and for improving the economics of conventional coal-fired systems.

161 (DOE/METC—87/6077, pp 98-102) **Physical mechanisms and predictive equations for coal-water slurry atomization.** Sojka, P.E. (Purdue Univ., West Lafayette, IN). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23254.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

This contract has four objectives: (1) to develop relationships for predicting Sauter mean diameter (SMD) when spraying Coal-water slurry (CWS) fuels through plain-jet and prefilming nozzles; (2) to determine the physical mechanisms responsible for the atomization of CWS fuels; (3) to quantitatively and qualitatively assess the effects of CWS rheology, nozzle geometry, and combustor operating conditions on CWS atomization; and (4) to suggest new types of fuel injection nozzles capable of producing finer CWS sprays. This paper discusses the results of the measurement of SMD and the effect of air gap width on CWS atomization. 5 references, 7 figures.

162 (DOE/METC—87/6077, pp 103-108) **Coal-water fuel combustion enhancement by means of high intensity acoustics.** Reethog, G.; Yavuzkurt, S. (Adiabatics, Inc., Columbus, IN). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

Once a coal-water fuel droplet enters a hot combustor, the surface water evaporates, the resulting dry particles are brought to ignition temperature, gas is expelled and burned, and the char is then combusted. The superimposition of an acoustic field is expected to increase heat transfer during evaporation and ignition and to increase mass transfer of oxygen during char combustion. A decrease in combustion time will lead to smaller and shorter combustors. Such acoustic fields can be produced by sound sources such as sirens which have the needed high acoustic efficiencies to make this approach economically viable. This paper discusses some of the technical aspects of this approach and describes a sonic coal-water fuel research combustor which is testing this technology. 4 figures.

163 (DOE/METC—87/6077, pp 114-118) **Tolerance of coal-fired gas turbines to deposition, erosion and corrosion.** Ahluwalia, R.K.; Im, K.H.; Hajduk, J.C. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of this task is to develop mathematical models which describe the formation and transport of vapor and ash in coal-fired gas turbines. These will identify the important surface deposition phenomena on turbine blades as well as characterize the effects of coal pretreatment and operating conditions on turbine performance. The contaminants entering a coal-fired gas turbine will consist of particulate matter (fly ash, nucleated ash, and unburnt char) and vapor species (primarily alkali sulfates). The ongoing efforts are directed toward adapting these models in conjunction with empirical data on ash adhesion, material erosivity, and material corrosivity to predict the fouling, erosion, and corrosion tolerance of coal-fired gas turbines. Results are discussed. 8 references, 4 figures.

164 (DOE/METC—87/6077, pp 150-154) **Chemistry of the interaction of sodium and sulfur in flames.** Steinberg, M. (Univ. of California, Santa Barbara). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The primary objectives of the contract are the identification of the dominant reactions and the development of a general chemical kinetic model for the interaction chemistry of sodium and sulfur in flames. One motivation for the study is a better understanding of the chemistry that leads to sodium sulfate and corrosion in combustion driven gas turbines. An experimental program involving rich and lean hydrogen/oxygen/nitrogen and acetylene/oxygen/nitrogen flames doped with sodium and sulfur is designed to provide a very broad data based. Flames are chosen to provide a wide range of compositions and flame temperatures which in turn yields a widely varying concentrations of the chemistry controlling radicals. The sodium line reversal method is used to monitor flame temperature profiles. Laser induced fluorescence is employed to monitor sodium and hydroxyl as a function distance (and time) above the burner. Given the temperature, [OH], and [Na] measurements, the other radicals and flame generated sulfur products are calculable. This is then the starting condition for application of kinetic modeling. The program for sodium oxidation calculates the sodium oxidation products with [OH] and temperature as inputs. This program is being extended to include sulfur influences and model the sodium-sulfur chemistry. Results to date are discussed. 4 references, 9 figures.

165 (DOE/METC—87/6077, pp 155-161) **Advanced combustion phenomena/heat engine utilization of low-rank coal.** Jones, M.L.; Mann, M.D.; Swanson, M.L. (Univ. of North Dakota, Grand Forks). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract FC21-86MC10637.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The overall objective of these projects has been to expand the data base on the fundamental reactions of low-rank coals in pressurized combustion systems such as those found in heat engine applications. The low cost and higher reactivity of low-rank coal (LRC) and LRC slurries together with its non-agglomerating properties enhance LRC's potential as a fuel for the short residence times experienced in heat engines such as gas turbines and diesel engines. This research will develop data that will quantify the potential advantages of LRC slurries mentioned above; help in determining fuel specifications; and indicate needed design changes in the heat engines themselves. The investigation of LRC combustion properties under pressure will be accomplished using a constant volume combustion bomb, a single combustion cycle diesel simulator and a two stage gas turbine simulator, all of which are described. Results are given for a series of eleven sorbent-enriched coal-water slurry combustion tests to investigate sulfur capture. 1 reference, 3 figures, 1 table.

166 (DOE/METC—87/6077, pp 162-172) **Provide alkali species profiles using a well-characterized coal combustor.** Greene, F.T.; O'Donnell, J.E.; Robaugh, D. (Midwest Research Institute, Kansas City, MO). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-84MC21091.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of this project is the identification and measurement of the concentrations of alkali metal and other relevant species produced during the gasification of coal and during the combustion of coal under typical PFBC conditions. These data will be suitable for testing combustion and gasification models. The paper discusses the identification of the initial inorganic combustion products, typical single particle combustion histories, particle temperature histories and gas temperatures, and sodium reactions following devolatilization. 3 references, 4 figures.

167 (DOE/METC—87/6077, pp 173-181) **Laser induced fluorescence detection of mineral vaporization species.** Casleton, K.H.; Kanosky, J.P.; Gase, W.J. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The presence of mineral species in coal presents a number of potentially serious problems facing the successful development of heat engines which directly utilize coal-derived fuels. It is well known that mineral matter species released during the combustion of coal can lead to corrosion, erosion, or deposition in the power generation system. In addition, submicron-sized aerosols can be generated which are enriched in relatively refractory species such as silicon, magnesium, and calcium. Because this aerosol fume consists of very small particles, it offers a very large total surface area for condensation of corrosive species such as the alkalis. One mechanism which has been proposed to account for the relatively large concentrations of these refractory species found enriching this aerosol fume is a chemical reduction of the parent oxides by a reducing agent such as CO. The objective of this research effort is to study the reduction of oxides such as CaO, MgO, and SiO_2, which are representative components of the mineral matrix, and determine rate constants of the reduction of these species by CO. These experimentally determined reactions rates can then be used in predictive models and compared against experimentally observed loss rates in single-particle coal combustion studies to assess the importance of this chemical mechanism in the overall loss of mineral species during combustion. 12 figures.

168 (DOE/METC—87/6077, pp 197-202) **Fixation of alkali and trace metals in high temperature co-current entrained flow gasifiers and combustors.** Wendt, J.O.L.; Peterson, T.W. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objectives of this research are to determine how programmed process temperature profiles and additives influence alkali content of supermicron fly ash particulate matter and of submicron aerosol matter under high temperature gasification and combustion conditions. The research should also shed light on the most important mechanisms governing the fate of alkali metals during pulverized coal combustion and gasification. The research is conducted on a 2 kg/h pulverized coal downflow combustor, operated under fuel lean conditions and fuel rich conditions to simulate combustion and gasification conditions, respectively. The combustor is sufficiently large to simulate times, temperatures, particle/particle and particle/gas interactions as they occur in practical units, but also sufficiently well-defined to allow time resolution of the alkali-rich particulate concentrations to be measured and mechanisms to be inferred. Sampling is performed using a specially-designed isokinetic sampling probe and analysis of particles by atomic absorption, EDAX, and Scanning Auger Microscopy. Results are discussed. 1 reference, 6 figures.

169 (DOE/METC—87/6077, pp 283-290) **Experimental and theoretical studies on coal mineral matter deposition from combustion gases.** Rosner, D.E. (Yale Univ., New Haven, CT). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-85MC22075.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of this program is a quantitative understanding of the gas-side transport phenomena governing inorganic particle deposition- and vapor deposition-related turbine tolerance problems associated with direct coal combustion. Emphasis on diffusional mechanisms that deliver the mineral matter to surfaces (which determine larger particle sticking and metal alloy corrosion. These research results will also be useful in the conception and design of systems for the capture/rejection of particles and alkali compounds in/or downstream of coal-fired turbine combustors. Results to date are discussed. 24 references, 1 figure.

170 (DOE/METC—87/6077, pp 325-333) **Staged combustion evaluation of LRC fuels.** Rosfjord, T.J. (United Technologies Research Center, East Hartford, CT). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-84FC10615.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

This technology program is directed at evaluating the combustion characteristics of fuels embodying low rank coal (LRC) when fired at gas turbine conditions with combustor pressures up to 150 psig. Both slurry and dry powder forms of fuel are being studied. The parent coals include subbituminous and lignite varieties. The following sections describe the pressurized staged combustor and fuel system, test fuel properties, and preliminary test results. 3 references, 9 figures, 1 table.

171 (DOE/METC—87/6077, pp 334-338) **Can combustor tests.** Neuzil, P.A.; Tung, S. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objectives of the Can Combustor Tests are to: confirm that the heat release of commercially acceptable coal/water fuels is high enough for heavy-duty industrial gas turbine operating pressures, temperatures, and flows; and initiate the experimental and analytical development of a full-size, direct fired, coal/water fueled combustor suitable for subsequent ash deposition tests and providing the basis for the development of a commercial applications. This paper describes the M56000 combustor used, fuel properties,

and preliminary test results from four different nozzles. 1 reference, 4 tables.

172 (DOE/METC—87/6077, pp 339-349) **Secondary atomization of CWF for gas turbine applications.** Beer, J.M. (Massachusetts Institute of Technology, Cambridge). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23253.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The main research objective is to determine the effectiveness of coal-water fuel (CWF) treatment on atomization quality when applied to an ultrafine coal-water fuel (solids loading reduced to 50%) and to gas turbine operating conditions (atomization at elevated pressure). Three fuel treatment techniques are proposed: 1) the heating of CWF under pressure to produce steam as the pressure drops during passage of the CWF through the atomizer nozzle, 2) the absorption of CO_2 gas in the CWF to produce a similar effect, and 3) the two combined. These techniques are expected to produce secondary atomization i.e., disruptive shattering of CWF droplets subsequent to their leaving the atomizing nozzle and, hence upon combustion, to yield better burnout and finer fly ash size distribution. The parallel objective is to present quantitative information on the spray characteristics (mean droplet size, radial distribution of droplet size, and spray shape) of CWF with and without fuel treatment in such a way that it is directly applicable to the design of CWF-burning gas turbine combustors. The design and construction of a pressurized spray test rig are described and results from water spray tests are discussed. 7 references, 7 figures.

173 (DOE/METC—87/6077, pp 350-358) **Evaporation rates and explosive fragmentation thresholds for CWF droplets.** Maloney, D.J.; Spann, J.F.; Tran, P.X. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objectives of this program are to: determine the energy flux conditions required to achieve explosive boiling of CWF droplets; compare the threshold energies and intensities with energy fluxes anticipated in high-intensity combustion applications; and evaluate the potential for achieving explosive boiling in practical combustion systems. The electrodynamic balance and the droplet imaging system used for this project are described. Results are discussed. 9 references, 4 figures.

174 (DOE/METC—87/6077, pp 359-368) **Combustion research for advanced heat engine power systems.** Dunn-Rankin, D. (Sandia National Labs., Livermore, CA). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The principal objective of the research is to determine the important combustion properties of pulverized coal (PC) and coal/water slurry (CWS) that will allow these fuels to replace the traditional gaseous and liquid fuels used by medium speed diesels and gas turbines. The evolution of the particle size distribution (PSD) of the fuel is examined as an indication of its combustion behavior. Because typical coal fuel is extremely polydisperse, it is better to relate combustion behavior to changes in the entire PSD than to changes in the mean particle size. Ignition, stability, combustion efficiency, and pollutant formation are all strongly influenced by the fuel particle size distribution. Specifically, this research examines the evolution of the PSD during PC and CWS combustion both experimentally and numerically, and then relates this evolution to physical properties of the fuel. 16 references, 4 figures.

175 (DOE/METC—87/6077, pp 404-419) **Injection and combustion studies of CWS in a diesel environment.** Benedek, K.; Cheng, W.K.; Lai, M.C.; Wong, V. (Arthur D. Little, Inc., Cambridge, MA). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-85MC22182.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objectives of this research are to establish a foundation of knowledge concerning the handling, injection, atomization, ignition and combustion of coal-water slurry (CWS) which will lead to design criteria for coal fueled engine development. Specifically, the goals are to: establish CWS handling procedures and hardware specifications to minimize clogging, drying, rusting, and other adverse effects; investigate the effects of nozzle geometry, slurry properties and injection parameters (fuel pressure, orifice diameter, orifice length) on CWS spray pattern and droplet size; investigate the effects of mixture preparation (spray pattern droplet size, air temperature, swirl) and CWS properties (particle size, solids content, etc.), on CWS ignition and combustion characteristics; and provide other team members (Cooper Bessemer, UTDS) with background and design guidelines for injector development and CWS engine preparation. The research program was conducted with two experimental set-ups: a high pressure inert gas chamber for injection work (with full optical access for high speed movies, still photography and optical droplet size analysis) and a Rapid Compression Machine (RCM) for parametric combustion studies. After describing both experimental set-ups, results from the injection/atomization and combustion tests are discussed. 7 references, 11 figures, 1 table.

176 (DOE/METC—87/6077, pp 420-434) **Combustion characteristics of coal fuels in adiabatic diesel engines.** Ryan, T.W. III; Likos, W.E. (Southwest Research Institute, San Antonio, TX). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-84MC21384.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The overall objective of this project is to determine if the higher temperature environment of the low-heat rejection diesel engine offers any new potential for utilization of coal in piston engines. The project had three specific goals. They were: to determine the ignition and combustion characteristics of three state-of-the-art coal slurries in an adiabatic diesel engine and compare with a baseline diesel fuel; to compare the ignition and combustion characteristics of the slurries in the adiabatic engine to those observed in a similar, but conventional, diesel engine and compare with the baseline diesel fuel; and to obtain preliminary data using a dry-powder coal injector in both the adiabatic and conventional test engines. The above goals have been expanded to include the evaluation of five coal-derived liquids. These coal liquids are to be evaluated in the research engine in a manner similar to the original fuels. Preceding the engine testing, the potential fuels will be analyzed in the fuels laboratory. Following the characterization, a decision will be made as to proceed with the engine tests, or modify the fuel as needed to make it more suitable for engine testing (i.e., correct a low cetane number by blending with diesel fuel). The engine, injection system, fuel formulation, and test matrix are described. Results are discussed of testing of coal-water, coal-diesel, coal-methanol-water fuels. 11 references, 8 figures, 7 tables.

177 (DOE/METC—87/6077, pp 435-449) **Comparison of the combustion characteristics of three coal slurry fuels.** Mecredy, H.E.; Jett, B.T. (Southwest Research Institute, San Antonio, TX). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

As a portion of the General Motors coal fueled diesel engine DOE contract, small engine combustion test work was performed on three coal slurry fuels (DF2/coal, water/coal and methanol/coal). These tests were performed in one cylinder of a minimally modified Detroit Diesel Allison Division (DDAD) 3-71 engine. Performance and combustion data were obtained at near full load and 900 RPM for the three slurry fuels as well as DF2. The water/coal and methanol/coal fuels were run with a pilot charge of DF2, although at some conditions the methanol/coal slurry would autoignite. The results show that all of the slurries will ignite and burn, but with significantly higher exhaust smoke and relatively low thermal efficiencies. Rate of heat release diagrams are included for comparison. Work is planned to address the less than optimal combustion performance by altering the combustion chamber. 2 references, 13 figures, 2 tables.

178 (DOE/METC—87/6077, pp 450-464) **Ignition study of coal water slurry fuel in GE-7FDL engine.** Hsu, B.D. (General Electric Corp., Schenectady, NY). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-85MC22181.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

A modified standard diesel fuel injection equipment (FIE) is used in this phase of the engine tests. Due to the low volumetric density of coal-water slurry (CWS) compared to diesel fuel, only 1/3 of the full load energy can be handled by this FIE system. Therefore the objective of this portion of engine test is only to investigate the ignition of CWS fuel in actual engine operating at full speed of 1050 rpm. Three methods of igniting the CWS in engine cylinder have been investigated. They are as follows. 1) Compression ignition - CWS was ignited solely by the compression temperature generated inside the engine cylinder. 2) Separate pilot diesel fuel injection - a separate pilot injector was used to supply a small amount of pure diesel fuel to ignite the CWS which was injected through the main injector. Two separate injectors were used in this case. 3) Combine CWS and diesel fuel injection - a small amount of diesel fuel was delivered to the cylinder through the main fuel injector. As the fuel was discharged from the injector, the first part consisted essentially of diesel fuel and the rest mostly of CWS. The first part of the fuel was easily ignited due to high concentration of diesel fuel and the heat thus generated assisted the burning of subsequently entered CWS. Only one injector is used. After describing the test hardware and fuels, results are discussed. 6 references, 14 figures, 7 tables.

179 (DOE/METC—87/6081, pp 3.A1.1-3.A1.19) **Performance characteristics of Texas lignites in AFBC.** Mann, M.D.; Hajicek, D.R.; Zobeck, B.J. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Tests were performed on UNDERC's 2.25 ft² AFBC assessing the operability and environmental performance for the AFBC of South Hallsville (Wilcox Group) and Gibbons Creek (Jackson Group) Texas lignites. Performance was characterized over a range of conditions - bed temperature (1450, 1550, and 1650°F), superficial gas velocity (3, 5, and 7 ft/sec), and expanded bed height (3 and 4 ft). Both silica sand and Paris, Texas limestone were used as bed materials. In addition, a 1000-hour test was completed on UNDERC's 0.44 ft² AFBC to assess corrosion/erosion potential of typical materials of construction for an AFBC boiler with the South Hallsville lignite. The highest sulfur capture was obtained at 1450°F for South Hallsville and for Gibbons Creek lignites. Sorbent addition at an alkali-to-sulfur ratio of 3.5 to 4.0 was required to meet 1979 NSPS. NO/sub x/ emissions were below 1979 NSPS at all conditions tested. Combustion efficiency was as high as 99.8% for optimum test conditions. Baghouse collection efficiencies and particulate size distributions and resistivities were determined at various conditions. EP leachate testing on solid wastes resulted in all RCRA elements below established federal limits. Based on the results of the 1000-hour corrosion/erosion test; it is projected that metal loss rates for the stainless steels tested would be acceptable if the metal surface temperature is maintained below 1300°F; and less deposition, pitting, and sulfide attack would occur to tubes in the convective sections of the boiler compared to the tubes located in the bed and splash zone. 8 references, 10 figures, 8 tables.

180 (DOE/METC—87/6081, pp 3.A2.1) **Physical model of radiation heat transfer in fluidized beds.** Zhen-Ting, S.; Ying, P. (Shanghai Univ. of Engineering Science, China). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

A single particle model for estimating heat conduction, convection and radiation in high temperature fluidized beds has been developed. This physical model is clear and convenient for computation, especially since no empirically determined factors enter into the model. Using the model, the overall heat transfer coefficient and the radiation heat transfer have been calculated for different size particles at different bed temperatures. A satisfactory agreement between calculation and experiment has been obtained.

181 (DOE/METC—87/6081, pp 3.A3.1-3.A3.16) **Firing low-rank coal/water fuel in a fluidized bed combustor.** Zobeck, B.J.; Mann, M.D.; Potas, T.A.; Maas, D.J. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Tests assessing the technical feasibility of burning hydrothermally-treated low-rank coal/water fuel (CWF) in an atmospheric, bubbling fluidized bed combustor (FBC) were performed at the University of North Dakota Energy Research Center (UNDERC). The fuel for the tests was prepared using UNDERC's hydrothermal coal dewatering process, a process for removal of liquid water from high moisture coal by heating the coal under pressure in a water medium. The inherent moisture of the coal particles is liberated and tars form closing coal micropores after cooling, preventing moisture readsorption. The resulting hydrothermally-treated coal/water fuel has a significantly higher solids and Btu content than unprocessed slurry. The fuel used for the testing was a Sarpy Creek (Absaloka Mine) Montana subbituminous CWF with approximately 60% dry solids. The CWF was prepared in a 200-lb/hr continuous hydrothermal process development unit. An 18 x 18 in FBC was used for the combustion tests. The CWF was pumped directly into the dense-bed zone of the combustor through a simple, water-cooled pipe without the aid of a nozzle or atomizing air. Operation of the combustor was extremely stable when firing the CWF. Testing was also performed with a coal/water/limestone fuel (limestone added after hydrothermal treatment) which simplified the entire solids feeding system. Results from this testing are compared to previous results when feeding the same coal as received (dry coal screw fed into combustor). 11 references, 8 figures, 5 tables.

182 (DOE/METC—87/6081, pp 4.A3.1-4.A3.19) **Ash deposition studies of low-rank coals in a laboratory furnace.** Conn, R.E.; Benson, S.A.; Austin, L.G. (Pennsylvania State Univ., University Park). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

A vertical externally-heated tube furnace was used to form ash deposits from low-rank coals under conditions similar to those in a utility boiler. In tests with this apparatus, a thin stream of coal was combusted in a muffle tube with a maximum hot zone temperature of 1500°C. The residence time of coal particles within the muffle tube was estimated to be between 1-2 seconds. Near the furnace exit a deposit was formed when the fly ash and products of combustion were accelerated by a nozzle up to 16 and then impinged on a pre-oxidized boiler steel substrate held at 500°C. A variety of low-rank coals were tested in the tube furnace including western US subbituminous coals, Fort Union lignites and Gulf Coast lignites. The effects of ion-exchangeable cations and oxygen partial pressure on deposit formation rate and strength were evaluated. Many of the low-rank coals combusted in 20% excess air produced strongly bonded deposits. However, a marked difference in deposit characteristics was noted for the Gulf Coast lignites compared to the other low-rank coals after combustion at high oxygen partial pressure (60% oxygen). The Gulf Coast lignites formed strongly bonded deposits while the other low-rank coals formed deposits with little mechanical strength. As expected, most of the sodium and calcium was removed from the low-rank coals by ion-exchange with ammonium acetate. The ion-exchanged Gulf Coast lignites combusted in 20% excess air formed fused, strongly bonded deposits while the ion-exchanged subbituminous and Fort Union lignites formed much weaker deposits. The difference in deposition behavior between the Gulf Coast lignites and other low-rank coals may be attributed to a different type of alkali bonding within the coal mineral matrix. 5 references, 8 figures, 7 tables.

183 (DOE/METC—87/6081, pp 6.B1.1-6.B1.12) **Design of Montana-Dakota Utilities 80 MW AFBC retrofit.** Mann, M.; Perna, M.; Imsdahl, B. 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Montana-Dakota Utilities (MDU) Co.'s Unit 2 at the R.M Heskett Station has recently been retrofitted to atmospheric fluidized bed combustion (AFBC). This bubbling-bed unit is designed to burn a high sodium North Dakota lignite. The unit is expected to show improved overall performance and increased boiler capacity as a result of the retrofit. The new AFBC combustor was designed and installed by Babcock & Wilcox. This project is currently the largest utility AFBC contract funded solely by the utility itself. To evaluate and determine appropriate design parameters, a test burn of the fuel was conducted on the 6 ft by 6 ft AFBC test facility at the B & W research center. During this test, potential agglomeration problems such as those encountered by the University of North Dakota Energy Research Center when burning this fuel were investigated. Other objectives of the test burn were to evaluate the overall operability performance, especially combustion efficiency, and to evaluate emissions characteristics, focusing primarily on expected ESP performance. Results of this pilot testing and the successful retrofit of the MDU facility demonstrate that FBC can satisfy utility markets' increasing need for power plant upgrades, utilization of available low cost fuels, and emission reductions. The importance of pilot testing to determine the optimal design and operating requirements of a utility system was clearly demonstrated during this project. Results from the pilot testing and the design of the 80 MW retrofit are discussed. Available information on the construction and startup of the unit are also presented. 7 references, 2 figures, 2 tables.

184 (DOE/METC—87/6081, pp 6.B2.1) **Capital costs for fluidized bed installations utilizing lower grade fuels.** McComas, M.W.; Thies, L. (Burns & McDonnell Engineering Co., Kansas City, MO). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Because large-scale, commercial fluidized bed boiler technology has only recently been introduced in the US, there is limited published information available on the capital costs of such facilities. This paper provides insight into the typical range of capital costs for large (50-200 MW) fluidized bed projects for industrial generation or utility power plants. In addition, the paper addresses, based upon their experience, the fundamental factors which cause the costs to vary on a project-to-project basis. Burns & McDonnel is involved in a number of large fluidized bed cogeneration projects for which capital costs have been determined. These costs have been established, for the most part, by obtaining firm, lump sum bids for the entire project or, in some cases, by developing definitive costs estimates. This cost data has been tabulated in a form which permits relationships to be derived between capital cost and two sizing criteria: the rated boiler steaming capacity and the electrical output of the plant. The tabulated cost data cover four or five fluidized bed projects, utilizing lower grade fuels, including the steam flows and electrical capacities. The owners and locations of the individual projects are not revealed in the tabulation.

185 (DOE/METC—87/6081, pp 6.B3.1-6.B3.22) **Northern States Power Company Black Dog generating plant - unit 2.** Jenness, B.L.; Rens, D.W.; Wong, H.K.; Kowalski, E. (Foster Wheeler Energy Corp.). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The Black Dog Project is a 130 MW Atmospheric Fluidized Bed Combustion (AFBC) boiler retrofit firing western coal in a fluidized limestone bed. Initial operation was in July of 1986. The Unit 2 boiler at Northern States Power Company's (NSP) Black Dog Plant was originally commissioned in 1954 as a pulverizer coal boiler rated at 100 MW. When firing western coal the unit was down rated to 85 MW. In late 1984 work began to extend the life of the unit and convert it to an AFBC. The conversion not only returned the unit to its original capacity but increased capacity to 130 MW. This paper is an update of the project's progress through January 1987 and discusses the design, start-up activities and experiences of note encountered by the project to date. The specific areas that are addressed are the AFBC boiler operation from steam blow through commercial operation. 5 figures, 3 tables.

186 (DOE/METC—87/6081, pp 7.B1.1) **Boiler fouling: experimental versus full-scale behavior of Loy Yang coal.** Anderson, B.; Bailey, K.P.; Bell, J.B.; Ottrey, A.L. (State Electricity Commission of Victoria, Richmond, Australia). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

In anticipation of the development of a new open cut/power station complex at Loy Yang, a range of coals from this area were tested in an experimental furnace. The main features of Loy Yang area coals are a generally low ash content with, dependent on location and depth, significant levels of sodium-in-ash. Subsequent to the major bore-hole analysis program, significant concentrations of acid-extractable aluminum have also been identified in some of the coal; this constituent can have a marked influence on ash behavior. Several parameters based on the analysis of the coal have been formulated to describe the ash behavior of these Loy Yang coals. In particular, the rate of ash fouling is strongly correlated with the level of sodium-in-ash, although the rate of fouling was lessened at a moderate ratio of acid-extractable aluminum to sodium in the coal. Initial operation of the first two 500 MW units of the Loy Yang A power station have generally confirmed (at least qualitatively) the findings of these experimental furnace tests. Extensive monitoring of convection pass (water and steam-side) temperatures and flow rates, combined with back-end flue gas temperature provide the basis for detailed boiler performance calculation and fouling assessments. Rapid deterioration of the furnace heat transfer is the most serious effect of this high fouling, low ash coal. The subsequent combustion of high ash, low sodium content coal can also cause further deterioration of furnace heat transfer. To date, convection pass fouling has not been a serious problem in these boilers. Some action has already been taken to reduce the rate and impact of furnace fouling. Work is also currently in progress to define the extent of this high fouling coal and to determine the nature of the ash deposition.

187 (DOE/METC—87/6081, pp 7.B3.1-7.B3.15) **Producing electric power from low grade lignite: experience gained in the design, construction, and operation of Central Station power plants utilizing lignite from the Jackson Formation in Texas.** Edwards, T.G. (Tippett & Gee, Inc., Abilene, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

This paper outlines the comparison of Jackson group lignites with other Texas lignites, and gives a review of the power plant design approaches of other utilities in projects utilizing Texas lignites. The paper traces the history of the San Miguel and Gibbons Creek projects from the conceptual design through the development of the specific design and construction, and through the operating experiences. Wherever possible, conventional design was used including pulverized coal radiant furnace designs. Description is given of the fuel delivery procedures; the fuel handling systems, the steam generators, including pulverizers, fans, air heaters, and other auxiliaries; and the environmental protection control strategies. The performance of the boiler is discussed with comparison of original design and realized operation. This paper further outlines the specific major problem areas of furnace fouling, bottom ash removal, component erosion, and fly ash removal resulting from ash quantities as high as 70 pounds per million Btu; flowability of fuel with moisture as high as 40%; flue gas desulfurization; and pulverizer and fuel pipe erosion. The experiences gained during design, construction and operation of the San Miguel and Gibbons Creek Plants have been used in upgrading these plants and in conceptual designs of other plants. This paper summarizes features of these programs. 23 references, 1 figure, 3 tables.

188 (DOE/METC—87/6081, pp 2.C1.1) **Lignite development in Pakistan.** Ilias, G.M.; Huber, D.W. (Water and Power Development Authority, Lahore, Pakistan). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Pakistan possesses extensive deposits of sub-bituminous and lignitic coal, which up to the present has received little developmental attention. Coal use for power generation so far exists only at Quetta on a scale of 15 MW in two stoker-fired steam generators. A major prospect for fully employing the coal resource and establishing a modern coal producing industry lies in the coal fields of Lakhra, near Hyperabad. WAPDA and USAID have collaborated and recently completed a comprehensive feasibility assessment to produce 500 MW of electricity from the Lakhra coal field. This Lakhra Project would require the establishment of two large surface mines and one underground mine, having a combined output of about 3 million tons annually. Washing and combustion characteristics of the coal have been tested in the US as part of the assessment. The Government of Pakistan has agreed that the implementation of the mining activity will be in the hands of the private sector. Meanwhile, the Geological Survey of Pakistan has a large exploration program underway to develop better and more definitive knowledge of the coal resource in terms of identifying immediate exploitation opportunities. Another prospective market for Pakistani coal lies in the manufacture of smokeless fuel briquets to replace scarce fuelwood and the use of petroleum fuels. The paper concentrates on the power generation aspects of coal development in Pakistan, discusses the progress made so far, the technical problems encountered, and the role foreseen for Pakistani coal in helping to alleviate the serious power supply shortfalls that exist in the country.

189 (DOE/METC—87/6081, pp 2.C3.1-2.C3.15) **Commercial low grade coal development in Costa Rica.** Ramirez, O.; Lam, E.Y.; Sabadell, A.J. (Refinadora Costarricense de Petroleo, San Jose, Costa Rica). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

The Government of Costa Rica has initiated a number of programs to develop indigenous low grade coal. In 1983, a program for exploration was formulated by U.S.A.I.D. in cooperation with the US Geological Survey (U.S.G.S.). Most of the work for this program was completed in the summer of 1985. The work included exploratory drilling, geophysical logging, collecting core and cuttings samples, coal analysis and surface mapping. The exploration program was followed up by a mining feasibility study for coal deposits in the Uatsi project area in the Baja Talamanca coal field near Limon. The report concluded that extraction of coal from the deposits of the Uatsi project area was technically feasible. A further U.S.A.I.D. sponsored study to develop a preliminary conceptual design has been completed for a 50 MW(e) coal fired power plant, and has provided order of magnitude capital and operating cost estimates for evaluating power generation alternatives. Additional aspects of this study also included the substitution of coal at cement facilities. A significant aspect for the development of Costa Rica coal will be the policy changes and fiscal incentives needed for potential private sector participation. This paper summarizes the findings of the coal fired power plant and cement plant conversion studies and makes recommendations on Costa Rica's plan to develop the Uatsi coal deposit for these potential projects. 5 figures, 2 tables.

190 (DOE/METC—87/6081, pp PS.6) **Fundamental studies of ash formation during the combustion of low rank coal.** Green, F.T.; O'Donnell, J.E.; Montgomery, G. (Midwest Research Institute, Kansas City, MO). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—). Contract AC21-81FC10287.

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Coordinated vapor phase, coal/ash and temperature measurements permit the determination of the behavior of the various species during the combustion process in both the vapor and condensed phases. The gaseous species were identified and their partial pressures measured as a function of distance along the flame axis using molecular beam mass spectrometry (MBMS). Coal/ash samples were collected as function of distance along the flame axis and analyzed by SEM/EDX, ESCA, and other techniques. Flame temperatures were measured using a thermocouple technique. For the alkali metals the only significant gaseous species observed to date are sodium and sodium hydroxide. Profiles of these two vapors indicate that a very large excess of Na(g) is produced early in the combustion of both Beulah and Decker, and that this excess is very short lived and decays either by reactions to form undetected gaseous sodium species or by conversion into a condensed phase. Downstream of the Na(g) spike the partial pressures of Na(g) and NaOH(g) are relatively constant. This is consistent with existing thermochemical data. Traces of Na_2SO_4 were also measured. The particulates present at different positions in the Decker and Beulah flames were sampled using a free-jet technique and collected without the use of an interfering substrate. Analyses of the samples were carried out using ESCA. The resulting data indicate that part of the volatilized sodium is converted to a fume or other particulate form early in the combustion process, and that some of the sodium is collected on the ash particles.

191 (DOE/PC/79799—T3) **The demonstration of an advanced cyclone coal combustor with internal sulfur, nitrogen and ash control, for the conversion of a 23 MMBtu/hr boiler to coal: Quarterly report.** (Coal Tech Corp., Merion, PA (USA)). Jul 1987. Contract FC22-87PC79799. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000296/JAW.

As a part of the Department of Energy's Clean Coal technology Program, Coal Tech Corporation is demonstrating the near commercial readiness of an advanced cyclone coal combustor for "new" or "retrofit" applications on industrial or utility boilers. This advanced combustor can control SO_2 and NO/sub x/ emissions to near new source performance standards and at the same time retain and reject ash, sorbent, and sulfur compound solids as slag upstream of the boiler. Coal Tech has completed the design requirements for peripheral equipment necessary to operate the Coal Tech combustor firing dry pulverized coal. The combustor itself, rated at 30 million Btu per hour (MMBtu/hr), is already installed on a 23 MMBtu/hr oil/gas fired boiler belonging to Keeler/Dorr Oliver and located at Williamsport, Pennsylvania. Coal Tech has applied for operating permits for water and solids disposal and for air pollutant emissions. Long lead time equipment for the coal feed and the scrubber system have been ordered. This completes Phase I, the design and permitting phase of this project.

192 (NERDDP-EG—85-413) **Investigation of the fluidised-bed combustion of Esperance lignite. Phase II: sorbent investigations.** Mullins, P.J. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1984. vp. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The extensive deposits of lignite found near Esperance, Western Australia, are low grade and troublesome. In a collaborative program with Western Collieries Ltd, the CSIRO Division of Fossil Fuels has been examining fluidised bed combustion as a means of alleviating the fouling and corrosion problems likely to arise with direct firing of this lignite. The report covers work undertaken over a 12 month period, constituting the second phase of the collaborative program.

193 (SAND—87-1971C) **Coal slurry rheology and chemistry.** Lynch, A.W.; Cook, D.W. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 16p. (CONF-8709155—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014898/JAW.

From AR and TD solids transport contractors review meeting; Pittsburgh, PA, USA (17 Sep 1987).

Three well-characterized, generic surfactants (nonionic, anionic and cationic) were used to modify coal/water mixtures by changing the interaction between several coals of different rank and the slurry liquor. Each experiment involved one coal and one surfactant per experiment. The analytical and rheological results from these experiments have been previously reported. The thrust of the current program is to extend the work to shear rates expected during atomization. The program consists of the following elements: (1) design, fabricate and test a helical screw rheometer capable of developing shear rates to 10,000 sec^{-1}; (2) establish a capability to atomize slurries and monitor the spray using high speed photography; and (3) initiate a collaborative program with the Com-

bustion Research Facility at Sandia National Laboratories Livermore for the purpose of analyzing particulates in atomized and burned sprays. The helical screw rheometer was designed using technology developed for polymer processing. The rheometer acts as an extrusion pump when there is discharge of fluid, but when flow is interrupted a differential pressure develops across the length of the screw. Using the mathematical analysis developed for screw pumps, the rotation rate of the screw may be translated to shear rate and the differential pressure translated to shear stress. 9 refs., 11 figs.

194 **Alkali injection system with controlled CO_2/O_2 ratios for combustion of coal.** Berry, G.F. (to Dept. of Energy). US Patent Application 6-933,460. 21 Nov 1986. 11p. Contract W-31109-ENG-38. DE88000842 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000842/JAW.

A high temperature combustion process for an organic fuel containing sulfur in which the nitrogen of air is replaced by carbon dioxide for combination with oxygen with the ratio of CO_2/O_2 being controlled to generate combustion temperatures above 2000°K for a gas-gas reaction with SO_2 and an alkali metal compound to produce a sulfate and in which a portion of the carbon-dioxide rich gas is recycled for mixing with oxygen and/or for injection as a cooling gas upstream from heating exchangers to limit fouling of the exchangers, with the remaining carbon-dioxide rich gas being available as a source of CO_2 for oil recovery and other purposes. Several advantages are associated with the invention. First, by using a low CO_2/O_2 ratio, higher flame temperatures can be achieved, thereby substantially promoting the gas-gas reaction between alkali atoms and sulfur gases. Second, by providing a means for injecting additional CO_2 at various locations removed from the combustion zone, the heat transfer rate and cooling of the alkali sulfates can be tightly controlled without suffering either the loss in efficiency inherent in conventional gas recycle techniques or the added cost associated with the larger mass throughput rate and heat transfer surface area. Third, there is the ability to use the concept in retrofit applications by tailoring the CO_2 quantity recycled to match the heat utilization performance previously achieved using air as the oxidizing medium. Fourth, a natural reduction in nitrous oxides is achieved by eliminating the reaction of oxygen with the nitrogen in the oxidizer.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 15, 118, 148, 184, 941, 1000

195 (CONF-8610247—, pp 49-59) **Federal research in new coal markets.** Siegel, J.S. (Dept. of Energy, Washington, DC). 1986. NTIS MF A01. Order Number DE87008092/JAW.

From International clean coal technology congress; St. Louis, MO, USA (20 Oct 1986).

After reviewing the energy consumption and energy supply patterns of oil, natural gas, and coal, the paper briefly describes DOE's research and development efforts on advanced technologies for new coal markets. These include advanced combustors, e.g., pulsed combustor, vortex combustion, and slagging combustor, alternative fuels, atmospheric fluidized-bed combustion, heat engines, and mild coal gasification. 5 figures.

196 (DOE/METC—87/6081, pp 1.C1.1-1.C1.15) **Comparison of coal and lignite fuel costs for existing and new generating stations in Texas.** Niquette, T. (Northwestern Resources Co., Huntsville, TX). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Publicly available information is used to compare historical, current and projected costs of coal to lignite for generating stations in Texas. The cost of these fuels are compared on both a delivered price basis and at the busbar. Data is presented, as filed by utilities with various public agencies or as compiled by the agencies themselves. In all cases, lignite is found to be the least cost generating fuel. 6 references, 8 figures, 2 tables.

197 (DOE/METC—87/6081, pp 4.C1.1-4.C1.10) **Will lignite be used in the industrial sector of Texas.** Jackson, T.J. (North American Coal Corp.). 1987. NTIS, PC A99/MF A01. Order Number DE87012948/JAW. (CONF-870517—).

From 14. biennial lignite symposium on the technology and utilization of low-rank coals; Dallas, TX, USA (19 May 1987).

Lignite is presently a viable industrial fuel in the second largest lignite producing state, North Dakota, but it has not been utilized to any great degree in Texas, the largest producing state. The barriers to greater industrial lignite utilization in Texas are primarily economic and to a lesser degree, structural rather than technical. This paper compares the lignite industry in North Dakota and Texas, describing the Texas industry as captive, i.e., coal reserves are dedicated to a specific utility consumer so that the distribution network is a closed loop from the mine to the power plant. Competition from Western coal producers is also mentioned. It is concluded that lignite will be utilized in the industrial sector when it is competitive.

198 **(NERDDP-CS—86-16) Australian coal industry cost study 1985. Consultancy study report.** (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1985. vp. Dept. of Resources and Energy, GPO Box 858, Canberra, ACT 2601 Australia.

In March 1984, the National Research Group (NRG) of the Australian Coal Consultative Council released a study on 'The international competitiveness of the Australian coal industry, the factors affecting it and how Australian industry competitiveness can be assisted'. The study was largely based on a survey of coal industry costs prepared by civil and mining engineers, Longworth and McKenzie Pty Limited (LM), which presented an overview of industry cost structures as at end 1983. In October 1984 the NRG endorsed terms of reference for an updated cost study to be prepared by LM financed by a grant from NERDDC. The LM report, based on costs applicable in March 1985, was received in June 1985 and is incorporated with this report.

199 **(PB—87-212528/XAB) Current trends in Appalachian coal markets. Final report.** (ICF, Inc., Washington, DC (USA)). May 1987. 97p. NTIS, PC A05/MF A01.

Contents include: electric-utility coal demand under alternative scenarios (review of 1986 developments; electric-utility coal demand in the short-run; electric-utility coal demand over the longer-term); non-utility coal demand under alternative scenarios (overview of non-utility demand, the industrial sector domestic metallurgical coal uses; export markets); implications for Appalachian coal markets (Appalachian coal demand; Appalachian coal supply, employment in coal production, coal transportation developments, restructuring of the Appalachian coal industry).

0160 Health And Safety

REFER ALSO TO CITATION(S) 111, 1992, 1993

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 973, 974, 977, 978, 979, 980, 981, 982, 983, 984, 986, 987, 990, 991, 992

200 (EUR—10811, pp 3-6) **Community energy policy issues and coal research.** Reichert, K. (Commission of the European Communities, Brussels (Belgium)). 1987. European Community Information Service, 2100 M. Street, N.W., Suite 707, Washington, DC 20037. (CONF-860408—).

From Symposium on new methods and techniques of coal winning in the coal mines of the European community; Luxembourg, Luxembourg (23 Apr 1986).

The paper outlines community energy policy in the EEC and its effect on coal production and utilization. Objectives of the policy proposed in 1985 most relevant to coal and other solid fuels are: reduction of security risks through indigenous energy production, diversification of supply sources, greater flexibility in the supply system and effective contingency measures; and to maintain and if possible increase the present market share for solid fuels with

continued restructuring of the Community's solid fuels production industries. Community coal research is also described with the main fields of research as follows: roadway drivage systems; mine gases, ventilation and climate; winning methods; underground infrastructure; modern management; coal preparation; coking technology; coal combustion and utilization; and chemical and physical upgrading.

201 **(NP—7770285) Columbia - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 15p. (In German). NTIS (US Sales Only), PC A02. Order Number DE87770285/JAW.

The energy situation of Columbia is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

02 PETROLEUM

REFER ALSO TO CITATION(S) 1996

0201 Reserves

202 **(MEM/P—8703) Manitoba petroleum and natural gas tenure system.** (Manitoba Dept. of Energy and Mines, Winnipeg (Canada). Petroleum Div.). Mar 1987. 7p. (MICROLOG—87-03673). Petroleum Division, Manitoba Energy and Mines, 555 - 330 Graham Ave., Winnipeg, Man., Canada R3C 4E3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Various tenure systems have been used to grant the right to drill into and produce from Crown owned oil and natural gas rights. Dispositions have been governed by the Petroleum Crown Leasing Regulations and the Mines Act since 1979. The Regulation provides for public sales by sealed tender of certain agreements, of which there are two types : Exploration Reservation and Freehold Leasing. Details are provided regarding fees, rentals, and special provisions of each in addition to contact addresses.

0202 Geology And Exploration

203 **(PB—87-218715/XAB) Geologic report for the St. George Basin planning area, Bering Sea, Alaska. Final report.** Comer, C.D.; Herman, B.M.; Zerwick, S.A. (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Jun 1987. 104p. (OCS/MMS—87/0030). NTIS, PC A06/MF A01.

The St. George Basin Planning Area is in the Bering Sea off the southwestern coast of Alaska. Two major depocenters, the St. George graben and the Pribilof basin, occur on the continental shelf within the planning area. The St. George graben is 10 to 25 miles wide, extends for over 200 miles, and contains as much as 40,000 feet of Cenozoic strata. The Pribilof basin is a half graben 30 miles wide, extends for about 70 miles, and contains as much as 20,000 feet of Cenozoic strata. Two Continental Offshore Stratigraphic Test (COST) wells and nine exploratory wells, all plugged and abandoned, have been drilled in the area. The COST well data indicate fair to good reservoir-rock potential in Oligocene sandstones; potential source rocks appear to be organically lean, gas-prone, and thermally immature.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 1343, 1743

204 **(BMFT-FB-T—86-205) Development of analytical methods for the characterisation of surfactants for enhanced oil recovery. Final report.** Krusche, G.; Greif, N. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); BASF A.G., Ludwigshafen am Rhein (Germany, F.R.)). Dec 1986. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753255/JAW.

The analytical characterisation of surfactants for enhanced oil recovery (EOR) is essential for predictions of the structure-efficiency-relationship. The objective for the reported work was the development of analytical methods for the quantitative determination of the major components of surfactants in oil/brine mixtures. The major interest has been put on the investigation of alkylphenolethoxylatecarboxymethylether and alkylsulfonates as well. Liquid chromatographic methods showed to be especially useful yet, the separation from the oil/brine matrix is an essential assumption. The effectiveness of the procedure has been tested on two examples: besides the determination of the surfactant concentration in phase tests the retention on sandstone cores has been determined in model flooding experiments. With 4 refs., 15 tabs., 22 figs.

205 **(DOE/CE/15252—T4) SST No. 312 oil well test system: Jones AWT system: Final technical report, April 1, 1986-August 31, 1987.** Jones, R.L. (Jones (Ray L.), Anaheim, CA (USA)). 15 Aug 1987. Contract FG01-86CE15252. 40p. NTIS, PC A03. Order Number DE87014220/JAW.

The Jones AWT system is a microcomputer-based system to accurately measure the production rates of oil, gas and water from producing oil wells. The existing AWT equipment normally utilized for obtaining these data are expensive, unreliable, slow and large in size. All such equipment require that the three fluids, oil, gas and water, be separated in order that individual flow-rate measurements can be made. Such systems are complex and operation is labor-intensive. The Jones AWT system is simpler and can collect the data without separation of such fluids. The objective of this grant was to facilitate further testing and analysis of this measurement concept in order to establish a technical foundation that will support wide application of the Jones AWT system in the oil industry. The following are specific objectives of this Grant effort: manufacture an additional Jones AWT system incorporating certain modifications based on the field experience from the initial system; conduct laboratory and field tests to determine the accuracy and precision of oil measurement under various conditions and with increased fractions of gas and/or water in the produced fluid. Accomplishments are: (1) fabrication was completed on the pre-production model Jones AWT system; (2) design and manufacture was completed for the PETS (Performance Evaluation and Test System) to be used to measure the performance parameters of the Jones AWT system during simulated severe field conditions; (3) conducted laboratory and field tests in which the accuracy of the output data was determined with special emphasis on the effects of gas content; and (4) continued the work on the computer mathematics model for the Jones AWT system. 15 figs.

206 **(DOE/EIA—0185(86)) Cost and indices for domestic oil and gas field equipment and production operations, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 11 Sep 1987. 174p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. Order Number DE87014992/JAW.

The costs of all equipment and services were those in effect during the month of June for each year. The sums (aggregates) of the costs for the hypothetical leases by area, depth, and/or production rate were averaged and indexed to provide a general measure of the increased or decreased costs from year to year for lease equipment and operations. These general measures may not represent industry-wide cost changes because of varying well mixes. Summary tables are included in the text of the report and detailed tables are included in the Appendices. Equipping and operating

costs for hypothetical oil leases, consisting of 10 wells producing by primary means (natural depletion) from depths of 2,000, 4,000, 8,000 and 12,000 feet, have been determined for 6 onshore areas of the lower-48 United States. Average lease equipment costs for the 6 areas and 4 depths decreased 11.1 percent to $982,600 during the 12-month period ending June 1986, compared to a 12.9% decrease for the previous year. The changes in equipment costs are primarily due to large changes in the price of tubular goods. Equipping costs, excluding tubing, decreased 1.8% and 4.1% for 1985 and 1986, respectively. Average estimated operating costs decreased by approximately 7.7% to $167,700 in 1986, compared to a 0.9% increase in 1985.

207 **(NIPER—256) Surfactant and cosurfactant properties of mixed and polysulfonated surfactant by phase volume measurements: Topical report.** Lorenz, P.B.; Brock, S. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Oct 1987. Contract FC22-83FE60149. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87001259/JAW.

This report covers work performed over a 3-year period with the goal of characterizing the oil-solubilizing properties of alkylaryl compounds with two or more sulfonate groups in the molecule. One material studied was a petroleum fraction, containing a large portion of diphenylalkanes, that had been oversulfonated. The other was an alkyldiphenyl ether sulfonate. Several monosulfonates were studied for comparison: a petroleum sulfonate (TRS 10-410), technical grades of sodium pentadecylbenzenesulfonate and sodium dodecylbenzenesulfonates; and two isometrically pure materials, sodium n-octylbenzenesulfonate and a branched-chain sodium tetradecylbenzenesulfonate ("Texas No. 2"). The experimental technique was measurement of phase volumes of surfactant-oil systems in alkane and salinity scans. All oils were pure or mixed alkanes from hexane to dodecane. Each surfactant system was characterized by its values of the parameters in the Salager correlation (1), along with the solubilization parameter and width of the 3-phase region. The results are reported in terms of how these parameters varied with polysulfonation, equivalent weight, mixing of surfactants, and calcium in the brine. A limited study was made of alcohol and sulfonate partitioning and their effect on interpretation of the data. It was found that many of the properties of polysulfonates are a consequence of their low equivalent weight. However, disulfonates are more water soluble, and act more like alcohols, than do monosulfonates of similar equivalent weight. They have less solubilizing power at the same hydrophilic-lyophilic balance, and they decrease the effect of calcium on the behavior. 24 refs., 50 figs., 21 tabs.

208 **(NP—8900092) Computer modelling of CO_2 enhanced oil recovery process: Final report for the 1986-1987 project year: Faculty research report No. 82.** Wang, G.C. (Alabama Univ., University (USA). School of Mines and Energy Development). 1 Aug 1987. 58p. School of Mines & Energy Devel., Box 6282, Univ. of Ala., Tuscaloosee, AL 35486. Order Number TI88900092/JAW.

A stream-tube type three-phase, three-dimensional numerical model has been developed. The model can be used to predict miscible CO_2 flooding performance in a five-spot pattern or a linear system. The report presents the stream tube concept which constitutes as the basic element of the numerical model. The mathematical formulation, including finite difference solution of the material balance equations, derivations of relative permeabilities in conjunction with Koval and shape factors, are discussed in detail. The calculated model results were verified with published data, as well as laboratory results from our own experiments. The agreements between the predicted performance and those actually observed are excellent. Further refining work to incorporate thermodynamic and phase behavior parameters should be considered. Modifications to expand the model to handle other miscible processes are desirable. 10 refs., 10 figs., 1 tab.

209 **(SAND—87-1766) BORE: A computer program for the analysis of wellbore heat loss associated with steam injection into oil reservoirs.** Hickox, C.E. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 34p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88001311/JAW.

The computer program BORE was developed for the analysis of wellbore heat loss associated with steam injection into oil reservoirs. The steam flow in the wellbore is assumed to be one-dimensional in the axial direction with quasi-steady heat transfer occurring only in the radial direction. Applications are restricted to cases for which the steam quality is between zero and one-hundred percent. The basic wellbore geometry treated consists of an insulated injection tube positioned concentrically within a casing and separated from the casing by an annular air gap. The casing is, in turn, surrounded by a layer of cement and is embedded in a formation which is infinite in extent. Steam quality, temperature, pressure, and enthalpy are computed as functions of depth for specified geometry, inlet flow conditions and thermophysical properties. 20 refs., 3 figs., 1 tab.

210 **Enthalpies of dilution of aqueous tetradecyltrimethylammonium bromide from 50 to 175°C.** Archer, D.G. (National Institute for Petroleum and Energy Research, Bartlesville, OK). *Journal of Solution Chemistry;* **16**: No. 5, 347-365(May 1987). Contract FC22-83FE60149.

Enthalpies of dilution of aqueous tetradecyltrimethylammonium bromide have been measured from 0.3 to about 0.002 mol-kg^{-1} and from 323 to 448 K at 1.03 MPa. Different methods of obtaining the enthalpy of micellization from experimental data are examined. Enthalpies of micellization calculated from these methods disagree by large amounts. From consideration of the temperature dependence of the average aggregation number and multiple equilibria equations for micellization, it is shown that there is an enormous dependence of micellization enthalpy on aggregation number of a micelle.

211 **Enhanced oil recovery system.** Goldsberry, F.L. (to Dept. of Energy). US Patent Application 6-947,791. 30 Dec 1986. 21p. DE88000854 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000854/JAW.

This invention relates generally to geothermal power control systems, and more particularly to a process encompassing the utilization of all energy resources available from a geopressured geothermal reservoir for the production of electric power and pipeline quality gas and the production and injection of engineered fluids for water and/or miscible flooding of depleted petroleum reservoirs. All energy resources available from a geopressured geothermal reservoir are used for the production of pipeline quality gas using a high pressure separator/heat exchanger and a membrane separator, and recovering waste gas from both the membrane separator and a low pressure separator in tandem with the high pressure separator for use in enhanced oil recovery, or in powering a gas engine and turbine set. Liquid hydrocarbons are skimmed off the top of geothermal brine in the low pressure separator. High pressure brine from the geothermal well is used to drive a turbine/generator set before recovering waste gas in the first separator. Another turbine/generator set is provided in a supercritical binary power plant that uses propane as a working fluid in a closed cycle, and uses exhaust heat from the combustion engine and geothermal energy of the brine in the separator/heat exchanger to heat the propane. 2 figs.

212 **Fatigue and crack growth of offshore structures.** Edmunds, England; Mechanical Engineering Publications Ltd. (1986). 150p. Mechanical Engineering Publications Ltd., P.O. Box 24, Northgate Ave., Bury St., Edmunds, Suffolk, England IP32 6BW.

A collection of papers which disseminate the results of a multi million programme of research which has been funded by SERC, Department of Energy, and the Offshore Industry. This Cohesive Fatigue Programme has been managed by University College London and is conducted through five UK Universities. The research was undertaken to provide information on the basic principles of fatigue of offshore structures. Fatigue is a major consideration for the offshore industry, as oil and gas recovery offshore becomes more technologically difficult, in deeper waters and more hostile environments. The results of the research will improve the fatigue life prediction for current platform designs and provide guidance in inspection requirements and the use of higher strength steels in environmental active conditions.

0204 Processing

REFER ALSO TO CITATION(S) 147

213 **(FRT—80-D-0860) Study of controlled cracking of heavy oils.** Blouri, B. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). 1983. 47p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750273/JAW.

Cracking of high molecular weight hydrocarbons (hexadecane, heavy paraffins C 21 to C 27,6-methyl eicosane and 1-phenyl dodecane) and especially saturated mixtures of vacuum distillates of crude oil from Kirhuh (Irak) is studied. A molecular mechanism is involved for cracking at moderate temperature, a low volume of gas is obtained and the ratio of paraffins/olefin is high in the liquid phase. In moderate cracking with hydrogen the ratio paraffins/olefins increase with hydrogen pressure. Heavy oil hydrocracking obtained is simpler than catalytic hydrocracking. 21 refs.

214 **(LA—10814-MS) The potential application of fuel cell cogeneration systems in petroleum refineries.** Altseimer, J.H.; Roach, F.; Anderson, J.M.; Krupka, M.C. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 120p. (DOE/MC—A146-2134). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001958/JAW.

The market potential for fuel cell cogeneration systems within the petroleum refinery industry is evaluated. Phosphoric acid (PAFC), molten carbonate (MCFC), and solid oxide (SOFC) fuel cells were considered. Conventional competitive systems now available including purchased power plus boiler-generated steam, gas turbine combined cycle, and a relatively new coke fluidized bed-boiler were characterized. Refineries use large quantities of steam at pressures ranging from about 15 to 650 psig. PAFCs can only meet a limited number of steam requirements because of their relatively low operating temperature. The high temperature MCFC and SOFC are technically much more attractive for this application. However, current estimates of their capital costs are too large to make the technologies competitive. The capital costs of MCFCs and SOFCs would have to decrease ~50% from their present estimated $1300/kWe. If costs could be decreased to give a 10% energy cost advantage to fuel cells, the industry projects that fuel cells might supply about 300 MWe by the year 2000, and modules in the 5- to 20-MWe size would be of interest. The market opportunities in refineries are varied - the industry is large, each plant is unique, thermal energy consumption is large, and both domestic and international competitiveness is intense. 10 refs., 26 figs., 17 tabs.

215 **Dispersion and catalysis of platinum in bimetal/zeolite catalysts.** Jiang, H.J.; Tzou, M.S.; Sachtler, W.M.H. New York, NY; American Institute of Chemical Engineers (1987). 24p. (CONF-870323—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers spring national meeting; Houston, TX, USA (29 Mar 1987).

Technical Paper 38D.

The dispersion and the thermal stability of Pt in zeolite Y is dramatically increased by non-reducible cations of transition or rare earth metals. These ions basically exert three functions: they can occupy exchange sites in small cages, thus forcing Pt ions to stay in supercages; they interact chemically with Pt particles, anchoring them to the zeolite matrix; and they act as catalyst promoters. Accordingly the authors found that Pt/FeNaY zeolite catalysts exhibit higher activities for benzene hydrogenation and n-hexane cracking than Pt/NaY, but the activity for methylcyclopentane (MCP) hydrogenolysis is lower for Pt/FeNaY. Catalysis of Pt/NaY is similar to that of Pt/SiO/sub 2/, but the ring opening selectivity of MCP is significantly different, presumably due to geometric constraints.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 944, 970, 998, 1000, 1001

216 **(CAN/ASQ—870130) Security of supply. An opportunity for Canada.** (Alberta/Saskatchewan/Quebec Energy Task Force (Canada)). 30 Jan 1987. 10p. (MICROLOG—87-02062). Alberta Energy and Natural Resources, Petroleum Plaza, South Tower, 9915-108 St., Edmonton, Alberta, Canada T5K 2C9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

A Task Force from the provinces of Alberta, Saskatchewan, and Quebec reviews Canada's "security of supply" oil situation and discusses the future availability and deliverability of crude oil on a regional basis. Opportunities for reducing future oil import dependence are addressed. 4 figs., 1 tab.

217 **(MEM/P—8704) Manitoba oil activity review.** (Manitoba Dept. of Energy and Mines, Winnipeg (Canada). Petroleum Div.). Apr 1987. 53p. (MICROLOG—87-03735). Petroleum Division, Manitoba Energy and Mines, 555 - 330 Graham Ave., Winnipeg, Man., Canada R3C 4E3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report reviews petroleum activity in Manitoba for 1986. Statistics are tabulated in the areas of geophysical activity and programs, drilling activity, exploratory oil and gas wells, production by field and operator, industry expenditures, crude oil reserves, direct revenues, crown royalties, and taxes from oil production. Included is a forecast of activity for 1987 with a description of two new provincial petroleum incentive programs.

218 **(NP—8900019) Oil in Tennessee.** Lamp, R.; Forester, C. (ed.). (Tennessee Dept. of Economic and Community Development, Nashville (USA). Energy Div.). Jan 1987. 50p. Tennessee Energy Div., Dept. of Economic and Community Development, 320 6th Ave., N, Nashville, TN 37219-5308. Order Number TI88900019/JAW.

Oil is the single most dominant force in the "energy outlook" and will continue to be throughout the foreseeable generations. Tennesseans now spend about $10 billion annually to satisfy energy needs; nearly half of that is for oil-based products. Most of the petroleum products sold are in the form of motor fuel, but a third of these products are made up of other categories, such as aviation and jet fuels, heating fuels, and lubricants. Baseline industry data is supplied.

0208 Waste Management

219 **(AD-P—005494/0/XAB) Dredging of polluted sediment in the First Petroleum Jarbor, Rotterdam.** D'Angremond, K.; Jong, A.J.D.; Waard, C.P.D. (Volker Stevin Baggermaatschappij Nederland B.V., Rotterdam). Mar 1987. 22p. NTIS, PC A02/MF A01.

This article is from United States - The Netherlands Meeting on Dredging and Related Technology (3rd) Held in Charleston, South Carolina on 10-14 September 1984, AD-A182 670, 169-190.

Papers previously published by the Municipality of Rotterdam on the removal of polluted bottom sediments from the First Petroleum Harbor explain that after long consideration it was decided that polluted material would be buried in deep pits in the bottom of the same harbor. Actual dredging operations in the First Petroleum Harbor have to fulfill some very strict requirements. First, the sediment has to be dredged, transported, and dumped with situ density because of the available space for disposal. Second, turbidity has to be avoided both at the dredging and the disposal location. For this purpose the cutter dredge OTTER was adapted and equipped with a specially designed suction head instead of the traditional cutter. Moreover, a special installation handled the methane gases available in the bottom sediments. This avoided negative effects in the suction process and also prevented escaping gas at the disposal site from causing turbidity. Finally,

process control equipment was installed to avoid unnecessary dilution of the dredged material.

220 (AFLW—870216) **Oil and gas drilling wastes: the potential for land farming.** Lloyd, D.A. (Alberta Dept. of Forestry, Lands and Wildlife, Edmonton (Canada). Public Lands Div.). 1987. 10p. (MICROLOG—87-03376; CONF-8702109—1). Alberta Dept. of Forestry, Lands and Wildlife, Information Centre, Alberta Energy, Main floor, Bramalea Bldg., 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

From Alberta soil science workshop; Edmonton, Canada (16 Feb 1987).

This paper was presented at the Alberta Soil Science Workshop, February 16-18, 1987, and is concerned with the often toxic waste materials produced during oil and gas drilling operations. High salt concentrations present the main toxicity concern. High pH, frequent oil contamination, and many drilling mud additives compound the waste toxicity. These drilling waste components are toxic to plants and animals and can also adversely affect soils at high concentrations. If the salts can be reduced to an acceptable level, however, the wastes can then be spread onto the soil surface. The drilling waste texture would improve sandy soil texture when the two are mixed. Any toxic organic components can be ameliorated by soil microbial activity and surface aeration. Land farming drilling wastes can help eliminate a toxic waste problem and potentially improve an unproductive sandy soil.

221 (KFK-PEF—12-Vol.2, pp 511-520) **Desulfurisation of liquid petroleum and petroleum fractions by oxidation with excited oxygen.** Suhr, H.; Becker, E.; Nauenburg, K.; Iacocca, D.; Gil, J.; Ropero, M.; Uslar, J.; Rodemeyer, S. (Tuebingen Univ., Germany, F.R. Inst. fuer Organische Chemie; Universidad Central de Venezuela, Caracas. Escuela de Quimica; California Univ., Fresno, USA). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

A method is being developed to desulfurize petroleum and its fractions by means of a plasma oxydation. The sulfur compounds are oxidized and form a second phase which can easily be separated on basis of its higher specific gravity. The method has been tested with representative sulphur compounds and simple mixtures of these with hydrocarbons. The present report reviews work of the second year of the project.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 950, 1800, 1814

222 (NP—7753271) **Polyurethane-flexible foam oil barrier production system for the protection of harbours, shorelines, and aquaculture projects. Final report.** Dietzel, K. (Aqua-Physik Dr. Dietzel, Krefeld (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1987. 51p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753271/JAW.

Among several sponsored projects concerning the combat of oil pollution a method and a prototyp of an oil barrier production system has been developed. This method produces continuously a barrier of flexible polyurethane foam at any length needed at the place of an oil spill off board a ship for the protection of harbours, shorelines or aquaculture facilities. The modulus system permits to build units of any size needed. The production speed of a barrier is, independent of temperatures and weather conditions, 250-400 metres per hour; a method and a prototype of a semiautomatic sewing device for the production of the skin, surrounding the floating element made up of flexible polyurethane foam. The production speed for this type of skin is about 1200 metres a day (24 working hours per day). With 17 refs., 1 tab., 17 figs.

223 (PB—87-213377/XAB) **Model development to predict hydrocarbon emissions from crude oil storage and treatment tanks. Final report.** Beckman, J.R. (Beckman (James R.), Tempe, AZ (USA)). 20 Jul 1986. 115p. NTIS, PC A06/MF A01.

A computerized mathematical model was developed to predict hydrocarbon emissions from crude oil storage and treatment tanks. The model predicts emissions from tanks that experience working, breathing, and flashing effects. Tanks simulated include wash, lease automatic custody transfer (LACT), and shipping tanks. Sensitivity analysis of all model input variables on emissions was performed along with a comparison of two test cases selected by ARB from 1977 WOGA field-test data. One test case involving working and breathing effects showed excellent agreement in hydrocarbon emissions and total off-gas values. The other test case dominated by flashing effects showed excellent agreement in hydrocarbon emissions, but it had 80% more predicted total off gas when compared with WOGA data.

224 (PB—87-215687/XAB) **Dispersion of oil on a water surface due to wind and wave action. Final report.** Bouwmeester, R.J.B.; Wallace, R.B. (Michigan State Univ., East Lansing (USA). Dept. of Civil and Environmental Engineering). Oct 1986. 159p. NTIS, PC A08/MF A01.

This report includes the results of a project to quantitatively describe the breakup of an oil film due to wind and wave action. The study was conducted employing a 17-m long wind-wave facility. The study was supported by visual observations and mathematical models describing aspects of the dispersion process. Evidence was found that the surface oil distribution is highly non-uniform and that there appears to be an accumulation at the face of a breaking wave. The oil-droplet diameters vary between 12 and 2000 micron. By extrapolating measured droplet size distributions at a depth of 18 cm to the surface using a simple dispersion model, the authors found that the number of droplets in size intervals is inversely proportional to droplet size. The dispersion characteristics of the water were described by an average eddy diffusivity estimated from a turbulence energy balance.

225 (PB—87-220083/XAB) **Oil-spill-response measures for offshore oil and gas operations. Final report.** Murrell, T.L.; Levine, J.R.; Regg, J.B.; Tennyson, E.J. (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Apr 1987. 197p. (OCS/MMS—87/0062). NTIS, PC A09/MF A01.

This report examines spill-response capabilities for arctic and subarctic Outer Continental Shelf (OCS) areas. The paper begins with a discussion of the regulatory requirements for pollution prevention and oil-spill-response planning, then describes the spill-response organization that industry has established to meet these requirements. Finally, the report examines the spill-response measures that have been proposed for the Alaska OCS Region and the research and development efforts underway to improve spill-response capabilities.

228 (PB—87-220240/XAB) **Assessment of fugitive emissions of PROC (photochemically reactive organic compounds) from petroleum-refining operations. Final report.** Peoples, S.H.; Thurn, C.J.; Steinmetz, J.I.; Oliver, W.R. (Radian Corp., Sacramento, CA (USA)). May 1987. 223p. (DCN—87-243-069-04). NTIS, PC A10/MF A01.

See also PB—80-225253.

An inventory of emissions of photochemically reactive organic compounds (PROC) from leaking and non-leaking components (valves, flanges, compressors, pumps, etc.) from California refineries is upgraded and compared to an inventory of emissions from refinery components prior to the inception of inspection/maintenance programs. Average emission rates for components are estimated from screening values. Screening values obtained using different monitors calibrated with different gases and measuring PROC from different distances from the leak source are correlated using predictive equations found in the literature. The correlation is then converted to mass PROC. The report also compares definitions for exempt components among the State's Air Quality Management and Air Pollution Control Districts and the average

number of leaking components among those districts. The major portion of the data used to compile the statistics for the report are data supplied by the refineries is fulfillment of the requirements of the districts' fugitive emission control regulations.

227 **(PB—87-221677/XAB) Draft regulatory impact analysis: proposed refueling emission regulations for gasoline-fueled motor vehicles. Volume 1. Analysis of gasoline-marketing regulatory strategies.** (Environmental Protection Agency, Washington, DC (USA). Office of Air and Radiation). Jul 1987. 358p. (EPA—450/3-87/001A). NTIS, PC A16/MF A01.

See also Volume 2, PB—87-221685.

The gasoline-marketing industry (bulk terminals, bulk plants, service station storage tanks, and service-station vehicle-refueling operations) emit to the atmosphere several organic compounds of concern. These include: volatile organic compounds (VOC), which contribute to ozone formation; benzene, which has been listed as a hazardous air pollutant based on human evidence of carcinogencity; and gasoline vapors, for which there is animal evidence of carcinogencity. The draft Regulatory Impact Analysis document is the first volume of a two-volume set that was prepared by EPA to fulfill the objectives of Title 3 - Executive Order 12291 (46 FR 13193, February 19, 1981) as they apply to future rulemaking on onboard control technology for controlling vehicle refueling air emissions. Volume I describes changes to an environmental and economic analysis published by EPA in 1984 (EPA-450/3-84-012a and b). Volume II summarizes the results of more-extensive supporting analyses of onboard costs and benefits that were prepared in the course of developing the onboard rulemaking (EPA-450/3-87-001b).

228 **(PB—87-221685/XAB) Draft regulatory impact analysis: proposed refueling emission regulations for gasoline-fueled motor vehicles. Volume 2. Additional analysis of onboard controls.** (Environmental Protection Agency, Washington, DC (USA). Office of Air and Radiation). Jul 1987. 48p. (EPA—450/3-87/001B). NTIS, PC A03/MF A01.

See also Volume 1, PB—87-221677.

The second volume supplements the first volume of the draft Regulatory Impact Analysis in fulfilling the objectives of Title 3 - Executive Order 12291 as they apply to the proposed onboard rulemaking. It provides a summary of the more-extensive support analyses of onboard costs and air-quality benefits that were prepared in the course of developing the proposed regulations. Alternatives to the proposed regulations are considered in Volume I. More specifically, the report summarizes the economic impact of the proposed rulemaking. It identifies the fixed and variable costs to manufacturers for systems development, certification, facility modifications, and emission-control hardware. Chapter 3 summarizes the air-quality benefits of the proposed rulemaking.

229 **(PB—87-221925/XAB) Investigations in Bantry Bay following the Betelgeuse oil-tanker disaster.** Grainger, R.J.R.; Duggan, C.B.; Minchin, D.; Sullivan, D.O. (Department of Fisheries and Forestry, Castleknock (Ireland). Fisheries Research Centre). 1984. 27p. NTIS, PC E05/MF E05.

Also pub. in Irish Fisheries Investigations, Series B (Marine), No. 27(1984).

About 30,000 tons of Arabian light crude oil plus some bunker oil was lost from the tanker Betelgeuse in Bantry Bay following an explosion and fire in January 1979. Most of the oil was burnt and, in the intense heat, more was polymerized into an asphalt-like material that coated the shoreline or sank, disrupting fishing activity. Oil leaked intermittently from the wreck for over a year during the salvage operation, and some of this was treated very effectively by spraying concentrated dispersant from an aircraft. Evidence of residual circulation suggested that the northern side of the inner Bay would have been most threatened by the dispersed oil. Several species of fish spawned in the Bay in the months following the disaster and larvae and post-larvae were not seriously affected. There was some very minor contamination of escallops Pecten maximus (L.) but this did not prevent escallop spatfalls in 1979 or 1980.

230 **(PB—87-222378/XAB) Overwater plume dispersion study. Final report.** Godden, D.; Hanna, S.; Scire, J.; Strimaitis, D. (ERT, Newbury Park, CA (USA)). May 1987. 73p. (ERT-P-D—569-140). NTIS, PC A04/MF A01.

See also Appendix, PB—87-222386.

The purpose of this study was to develop an air-quality modeling methodology to simulate the impact of emissions from oil exploration and production activities in California coastal waters. The study included the collection of data in a field program and the analysis of the data to determine a relationship between Gaussian dispersion coefficients and overwater transport distance and meteorological variable observed near the source and the shoreline. A plume of sulfur hexafluoride (SF_6) and visible smoke was released from an offshore location in the Santa Barbara Channel during onshore flow conditions, and the dispersion of the plume was documented by measuring SF_6 concentrations at various distances downwind and by taking a variety of photographs. Experiments were conducted in the Santa Barbara Channel during two one-week period in 1986.

231 **(PB—87-222386/XAB) Overwater plume dispersion study: Appendix. Final report.** Godden, D.; Hanna, S.; Scire, J.; Strimaitis, D. (ERT, Newbury Park, CA (USA)). May 1987. 178p. (ERT-P-D—569-140-A). NTIS, PC A09/MF A01.

See also PB—87-222378.

The purpose of this study was to develop an air-quality modeling methodology to simulate the impact of emissions from oil exploration and production activities in California coastal waters. The study included the collection of data in a field program, and the analysis of the data to determine a relationship between Gaussian dispersion coefficients and overwater transport distance and meteorological variable observed near the source and the shoreline. This appendix contains data taken during the study.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 201, 973, 974, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995

232 **(NP—7770283) Nepal - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 10p. (In German). NTIS (US Sales Only), PC A02. Order Number DE87770283/JAW.

The energy situation of Nepal is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

233 **(NP—7770284) Congo People's Republic - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 15p. (In German). NTIS (US Sales Only), PC A02. Order Number DE87770284/JAW.

The energy situation of Congo is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

234 **(NP—7770286) Syria - energy situation 1984/1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Dec 1986. 19p. (In German). NTIS (US Sales Only), PC A02. Order Number DE87770286/JAW.

The energy situation of Syria is reviewed on the basis of relevant data. An outline is given of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

235 **(NP—7770287) Yemen Arab Republic - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Dec 1986. 15p. (In German). NTIS (US Sales Only), PC A02. Order Number DE87770287/JAW.

The energy situation of Yemen is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 219, 238

236 **(CONCAWE—1/87) Methods of prevention, detection and control of spillages in West European oil pipelines.** Bown, J.R.; Bianchini, M.; Ligthart, M.; Noel du Payrat, C.; Whitmore, J.B. (Concawe, The Hague (Netherlands)). Jan 1987. 22p. CONCAWE, Koningin Julianaplein 30, 2595 AA The Hague, Netherlands.

This report reviews the causes of spillage from operating cross-country oil pipelines and discusses the current practice in spillage prevention, detection and control. Performance data for the past fifteen years shows that the rate of spillage has continued to be extremely low. The net spillage over de period 1971 to 1985 is approximately 0.0002% (one five-thousandth of a per cent) of the total volume transported. Data on spillages is recorded by CONCAWE and this knowledge assists in the continuous efforts to improve on the performance and minimise the effects on the environment. Spillages are prevented by competent design, careful construction, rigorous inspection and efficient operation. Monitoring of the pipeline provides the information necessary to satisfactorily maintain the system and to allow a reaction to deviations from the norm. Various techniques are available to prevent spillages occurring, and if they do, to detect, locate and thus minimise the volume spilled. In case of an emergency, contingency plans and training of operators aim at quick spillage control and at minimising the impact on the environment. The oil industry applies considerable effort to provide a safe and efficient pipeline transport service, whose performance record ranks amongst the best. Efforts will continue to be exerted to maintain and further improve on the high standards already obtained. 1 map, 1 ref.

237 **(PB—87-215919/XAB) GRI (Gas Research Institute) meeting on advanced gaseous-fuel transport systems held at Chicago, Illinois, August 26, 1986. Summary report. Final report, March-December 1986.** Annison, M.H.; Hefley, K.E. (Westrend Group Ltd., Denver, CO (USA)). Jan 1987. 38p. NTIS, PC A03/MF A01.

A new research program was initiated which has as its ultimate goal, the development of an Advanced Gaseous Fuel Transport System. It is envisioned that the new system will use advanced materials, components, and system designs with the capability to retrofit with the existing transport system and for extending new pipe. The first phase of this program is to define the specifications for the advanced transport system. Participants at the Meeting were asked to explore what they thought the gas industry may look like in the year 2000 and beyond. The discussion focused on elements that are not necessarily present in today's gas-transport system. The attendees generated lsts of key business opportunities and services for the gas industry in the future.

0240 Storage

238 **(EGG-REQ—7807) A RAM [Reliability, Availability and Maintainability] analysis of the proposed Tinker AFB Jet Fuel Storage Tank Facility.** Wright, R.E.; Sattison, M.B. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1987. Contract AC07-76ID01570. 194p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88001579/JAW.

The purpose of this study is to determine the Reliability, Availability and Maintainability (RAM) at the 30% design phase of a Jet Fuel Storage Tank Facility that is to be installed at the Tinker Air Force Base, Tulsa, Oklahoma. The Jet Fuel Storage Tank Facility was divided into four subsystems: Fuel Storage and Pipeline Transfer Pumps; Truck Unloading and Loading; Fire Protection (foam and water supply systems); and Electric Power. The RAM analysis was performed on four functions of these subsystems: transferring fuel from the two new 55K barrel storage tanks to the existing fuel pipeline system; transferring fuel from the two 55K barrel storage tanks to the aircraft refueler trucks; transferring fuel from the road transport trucks to the aircraft refueler trucks; and fire protection. A fault tree analysis was performed on each functional system. The quantification was performed for several mission times.

239 **(SAND—87-7111) Weeks Island Strategic Petroleum Reserve geological site characterization report.** (Acres International Corp., Buffalo, NY (USA); Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 247p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88001920/JAW.

This detailed geologic site characterization of the Weeks Island salt dome in Louisiana was carried out by Acres International Corporation under contract with Sandia National Laboratories. Acres was supported throughout this study by Dr. Thomas Magorian, Consulting Geologist and Geophysicist, who was engaged under a seprate contract with SNL. The Weeks Island dome includes the Department of Energy's Weeks Island Strategic Petroleum Reserve (SPR) crude oil storage site. The three principal areas covered by this study were: stratigraphy and lithology of the sediments adjacent to the dome; structure within the sediments adjacent to the dome; and geometry and structure of the salt dome. The objective of this study is to provide a thorough geological characterization and identify any structures which could adversely affect mining or storage operations of the facility. This characterization only addresses the geologic/geotechnical aspects of the Weeks Island facility and does not take into account other technical or non-technical DOE activities such as operations and surface facilities which could adversely impact the facility. Contents of this report include: summary; introduction; historical activities; surface and near-surface geology; stratigraphy and structure in and around the dome; stability of mines at Weeks Island; hazards; and appendices. 19 refs., 41 figs., 10 tabs.

0250 Combustion

REFER ALSO TO CITATION(S) 626, 660

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 202

240 **(PB—87-224812/XAB) Geologic assessment of natural gas from coal seams in the Warrior Basin, Alabama. Topical report, September 1985-September 1986.** McFall, K.S.; Wicks, D.E.; Kuuskraa, V.A. (Lewin and Associates, Inc., Washington, DC (USA)). Nov 1986. 125p. NTIS, PC A06/MF A01.

This study provides a detailed geologic assessment of the coal deposits in the Warrior Basin area that have high potential for natural gas from coal seams. The estimate of the natural gas in place in the four major coal groups is 19.8 trillion cubic feet. Although the bulk of the gas in place is in the deeper areally extensive Black Creek and Mary Lee coal groups, the more shallow Pratt coal group also shows good potential for coal seam gas. The most concentrated areas of methane in place are in the eastern portion of the Warrior Basin. These areas coincide with thick accumulations of high rank coals and their associated higher gas contents. These areas also appear to have been structurally altered, leading to enhanced permeability to gas and water. Thus, the eastern portions of the basin appear more favorable for coalbed methane production due to high gas contents, attractive coal thicknesses, closely-spaced coal cleats and joints, and moderate depths to the coal horizons.

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 203, 2012

241 **(DOE/MC/21179—2335) Rock matrix and fracture analysis of flow in western tight gas sands: 1986 annual report.** Morrow, N.R.; Buckley, J.S.; Cather, S.M.; Brower, K.R.; Dandge, V.; Graham, M.; Gonzales, B. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Feb 1987. Contract AC21-84MC21179. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87001100/JAW.

This report presents progress for the second year of a five-year project concerned with the pore structure and flow properties of low permeability gas sands. The main objective of work during the first year was to carry out advanced core analysis on cores recovered from the Multi-Well Field Experiment. In Phase 2, the properties of both fractured and non-fractured samples (hereafter referred to as matrix) have been studied. Special attention was given to the combined effect of overburden pressure and water saturation on gas flow. 11 refs., 18 figs., 4 tabs.

242 **(DOE/MC/21179—2378) Rock matrix and fracture analysis of flow in western tight gas sands, Phase 3: Quarterly technical progress report, April-June 1987.** Morrow, N.R.; Buckley, J.S.; Cather, S.M.; Brower, K.R. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). 1987. Contract AC21-84MC21179. 16p. (PRRC—87-7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013335/JAW.

Progress reports are presented for the following tasks: (1) advanced core analysis; (2) flow along and across fractures; (3) chemical alteration; and (4) effect of water on gas production. Much of the advanced core analysis work needed to aid in the selection of cores for other tasks has been completed. Three areas where work is continuing are electrical resistivity, clay analysis, and preparation of thin sections. For task 2, core analysis work on core samples containing calcite-filled natural fracture is continuing. The status of work performed to date on such fractures is summarized. Chemical alteration of various mineralogical components and resultant effects on permeability were investigated using sodium hydroxide and oxalic acid. For task 4, a topical report is currently in preparation on "Effect of Drying on Absolute and Relative Permeabilities of Low Permeability Gas Sands." According to this report, permeabilities of cores which had been allowed to dry tended to be higher than those of the fresh ones. 6 refs., 6 figs., 1 tab.

243 **(PB—87-229464/XAB) Eastern gas shale data-base development program. Annual report, January 1-December 31, 1986.** Keltch, B.; Pruett, L.T.; Vogel, M.D. (BDM Corp., McLean, VA (USA)). Jan 1987. 44p. (BDM/W—86-0273-TR). NTIS, PC A03/MF A01.

See also report for 1985, PB—86-229531.

The Gas Research Institute (GRI) Eastern Gas Data System (EGDS) is an interactive information resource developed to provide ready access to accurate data on Devonian-shale gas wells of the Appalachian Basin. The detailed, on-line comprehensive data source, collected directly from cooperating industry sources, includes identification, location, elevation, drilling, geology, cementing, perforation, stimulation, cleanup, and production histories on 2,037 wells. Updates to the production histories are maintained to keep the data current. The detailed data allows for a thorough evaluation of prospects by producers and can substantially reduce the cost of a drilling program in regions where the company previously had no formation or production information. To researchers, GRI contractors and producers alike, this concentrated data source has and will continue to reduce the lead time in gathering widespread, high quality and/or otherwise unavailable data. The various methods of access allow for all levels of computer expertise and sophistication in acquiring and utilizing the data. This includes remote interactive on-line access and data dumps or reports on hard-copy printouts, magnetic tape, or floppy discs for low-cost, in-house access.

244 **(UCID—21195) The LLNL sonic probe for in-situ stress measurements: A progress report on the second-generation tool: Unconventional Gas Program.** Nai-Hsien Mao. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001587/JAW.

The Lawrence Livermore National Laboratory's Unconventional Gas Program is pursuing the development of a borehole sonic tool to estimate in-situ rock stresses. A first-generation probe was developed in 1981-83 and the concept was confirmed in laboratory tests in large rock blocks. A patent (US Patent No. 4,641,520) for the technique and apparatus was issued by the United States Patent and Trademark Office on February 10, 1987. The second-generation LLNL sonic in-situ stress probe system was developed in 1984-86. It consists of the new LLNL sonic in-situ stress probe, a new data acquisition system which includes a Tektronix 7D20 digitizer, and new software to control it. Twelve cylindrical wedge transducers in 4 groups were embedded in a polyurethane loading cell. Each group has one transmitter and two receivers. Fron the travel time difference and the separation of the two receivers, absolute velocities can be calculated. New equations for back-calculation of stresses were derived to take the advantage of these absolute velocity measurements. The probe is also equipped with a dual pressurization system so that the pressures behind the transducers and bladder are separately controlled. The new system was assembled and checked in the laboratory, and then an initial field test of the modified prove was carried out at the Climax mine, Nevada Test Site, Nevada. This report discusses the new stress probe system, the laboratory test results, and the field test results. Recommendations are made for further development. 8 refs., 14 figs., 4 tabs.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 206, 212, 242, 243

0304 Products And By-products

245 **(AE/SESRD—1/172) Helium recovery from natural gas.** (Alberta Energy and Natural Resources, Edmonton (Canada). Scientific and Engineering Services and Research Div.). [1987]. 8p. (MICROLOG—87-03362). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Since 1976, many projects have been initiated in Alberta by industry and by academic research institutions for better utilization of the province's energy resources. Funding for research and development efforts is supported in part by the Alberta/Canada Energy Resources Research Fund. Program priorities have focused on coal, energy preservation, renewable energy, as well as conventional energy resources. Currently in the United States, helium is extracted from natural gas using a cryogenic process. This publication deals with an alternative process developed by the Alberta Research Council that uses semi-permeable membranes to extract helium from natural gas at lower concentrations (averaging 0.05%). A pilot plant was built to demonstrate the permeation process on a practical scale but plans for commercial development were postponed. 5 figs.

0305 Health And Safety

REFER ALSO TO CITATION(S) 1982

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 217, 970, 1003

246 **(ERCB—87/A) Gas supply protection for Alberta. Policies and procedures.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). Mar 1987. 43p. (MICROLOG—87-02799). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alberta, Canada T2P 3G4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

The Energy Resources Conservation Board has concluded that retention of the currently used gas surplus and deliverability tests which cover 25-year periods, would not be appropriate in the present deregulated environment. They are not in accord with the intent of the 1985 Agreement on Natural Gas Markets and Prices and would impede response to market forces. Their continued use would also retain the adverse effects of encouraging Alberta consumers to contract only for the short term while relying on a substantial mandated reserve of gas being set aside for their future use, if needed. The Board is satisfied that a simple calculation which would protect for 15 years of requirements by core users would be appropriate and that the test can be used as a guide to determine if there are gas reserves available for inclusion in new permits. The Board decided to determine the availability of gas for inclusion in permits on an annual basis and report the results. The Board has also decided to eliminate the deliverability test and, in its place, will periodically publish demand-supply projections for the information of interested parties. It will continue to apply its current practices for expediting small-volume permit applications of less than 2 years' duration. The Board is issuing a new informational letter which describes in detail the requirements of gas removal permit applications, and the procedures which will be used by the Board in processing those applications. The Board is seeking input from interested parties respecting those matters, prior to issuing the informational letter in final form. 2 tabs.

0307 Waste Management

REFER ALSO TO CITATION(S) 220, 655, 656

0308 Environmental Aspects

247 **(UCRL—53453) Two-phase flow design of the spill pipe system for the liquefied gaseous fuels Spill Test Facility.** Hipple, D.L. (Lawrence Livermore National Lab., CA (USA)). Jun 1983. Contract W-7405-ENG-48. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88000754/JAW.

Cooldown and pressure drop design of the liquid delivery pipe system are analyzed for a Spill Test Facility proposed for studying the effects and dispersion of spills of liquefied natural gas (LNG) and other liquefied gaseous fuels (LGFs). The design analyzed includes a 488-m (1600-foot) long, 0.61 m diameter (24 inch nominal size) delivery pipe to carry the LNG from the storage tanks to the spill area where experiments are conducted. Various methods of cooling the pipe to LNG temperature are examined. Cooldown with LNG flow at between 2.0 and 2.4 m^3/min is recommended because it is the fastest method and requires the least amount of on-site equipment of the methods examined. Pressure drop is also examined because 200 m^3/min flowrate must be achieved within the 1.03 MPa (150 psig) allowable pressure rating of the storage tanks. The LNG will be pushed out of the tanks and down the delivery (or spill) pipe by injecting pressurized nitrogen (N_2) gas into the tank vapor space. Existing tanks will be used, so their pressure rating of 1.03 MPa (150 psig) governs the design. The effects of phase change and two-phase flow in the spill pipe are included by use of the Martinelli and Nelson (1948) correlation for two-phase flow. A modification is made to the Martinelli and Nelson correlation at low qualities (below 1.8% for LNG) to account for uncertainty in the correlation at low quality. The results of the pressure drop analysis show that a flowrate of 200 m^3/min can be achieved with 1.03 MPa (150 psig) drive gas pressure. This assumes that the spill pipe is completely precooled (with no residual heat remaining) and that LNG is stored with a saturation temperature of not over 110.7°K (199.3°R) in the storage tanks (corresponding to a saturation pressure of not over 3.45 x 10^3 Pa (0.500 psig)). 32 refs., 10 figs., 9 tabs.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 1343

248 **(PB—87-223178/XAB) Hydraulic-fracture design rationale for the recovery of methane from coal seams. Final report, February 1985-September 1986.** Jones, A.H.; Bell, G.J.; Morales, R.H. (Terra Tek, Inc., Salt Lake City, UT (USA)). Jan 1987. 185p. (TR—87-42). NTIS, PC A09/MF A01.

Treatment pressures during coal-seam hydraulic-fracture operations usually demonstrate an early, steep pressure rise and overall treatment pressure very high, often exceeding the lithostatic pressure. In addition, the instantaneous shut-in pressures are high following a fracture treatment, while closure pressures are in agreement with measured in-situ stresses. However, there are cases for coal treatments where pressures remain at low levels comparable to other formations. This observed wide range of treatment responses cannot be explained by conventional-modeling approaches. An investigation into the physical causes of the unusual behavior of coal-seam stimulations resulted in the identification of new physical mechanisms for further consideration. Blockages of the fracture by coal chips and plugging of an advancing fracture tip by coal fines carried ahead of or within the fluid-treatment pad are mechanisms that consistently explain all of the observed behavior. Hydraulic-fracture design codes, which included the description of the coal fines accumulation at the fracture periphery, were used to assist in the design of hydraulic-fracture treatments at the Gas Research Institute, Multiple Coal Seam Field Project, at Rock Creek in Alabama.

249 **(PB—87-223988/XAB) Geopressured-gas supplementary subsidence study. Final report, November 1980-March 1987.** Statton, C.T.; Naumoff, P.G.; Agnew, J.D.; Johnson, D.O. (Woodward-Clyde Consultants, Wayne, NJ (USA)). Mar 1987. 357p. (REPT—80C5083). NTIS, PC A16/MF A01.

Significant increases in the natural-gas-reserve base may come from unconventional sources such as methane in brines that are contained in deep underground geological formations along the Texas and Louisiana coasts. As the brines are removed, there is concern about the occurrence of subsidence at ground level above these geopressured reservoirs. An instrumentation system, including tiltmeters, seismometers, and surveyed benchmarks, was installed at two geopressured test-well sites in Louisiana to monitor for subsidence. More than three years of data were collected. Subsidence related to production was inferred but the magnitude was small, in the range of 4 to 30 mm (total) for the three-year monitoring period. The information came from measurements and calculations, based on first-order levelling surveys and supported by the tiltmeter data. The suggestion of subsidence occurred nearly instantaneously with production - no time lag was noted. The extent of the effect approximates a one-to-one volume relationship with production. Microseismicity did not accompany fluid withdrawal of 1.3 million barrels. Environmental issues related to developing the geopressured aquifer resource - subsidence and induced seismicity - were evaluated and found not to be a major concern for the volume of fluid produced.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 201, 232, 233, 234, 235, 246, 973, 974, 976, 977, 978, 979, 980, 981, 982, 983, 986, 987, 988, 989, 990, 991, 992, 993

250 (NEB-SS—860714) Reasons for decision, TransCanada Pipe Lines Limited. (National Energy Board, Ottawa, Ontario (Canada)). May 1987. 116p. (RH—3-86). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ontario, Canada K1A 0E5; $N/C.

On February 21, 1986, TransCanada applied to the National Energy Board for new tolls including an increase in tolls of approximately 6% effective January 1, 1987, an increase in the utility's deemed common equity ratio from 30% to 35% and a continuation of its 14.5% authorized return on equity. The Company also proposed to maintain tolls at the existing level by drawing down a portion of its deferred income taxes to offset cost increases. The Company proposed a three-part toll design consisting of a demand charge, a non-fuel related commodity charge and a separate commodity charge for fuel and fuel-related costs which would change monthly. The Board denied TransCanada's three-part toll proposal because they believed it would be cumbersome. The Board directed TCPL to file uniform toll schedules incorporating the approved tolls which are to be effective July 1, 1987. TransCanada requested the Board to increase the equity component in its capital structure from 30% to 35%. The Board denied this request. The Company requested the same rate of return as previously allowed for the common equity component of its capital structure. The Board reduced it from 14.5% to 13.25%. The Board rejected TCPL's proposal to draw down the balance of its accumulated deferred income taxes to offset other costs and to maintain tolls at their current level. The approved tolls provide for the recovery of the net differences between the 1986 revenue deficiency and the 1987 revenue surplus, and carrying charges, over the final six months of the test year.

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 250

251 (PB—87-215794/XAB) Development of an energy flowmeter. Phase 3. Final report, June 1984-December 1985. Clingman, W.H.; Hall, K.R. (Precision Machine Products, Inc., Dallas, TX (USA)). Jan 1986. 81p. NTIS, PC A05/MF A01.

On a previous contract, GRI 5081-271-0001, an energy flowmeter was developed and a first prototype successfully tested at a natural desulfurization plant. Under the present contract, the dynamic range of the flowmeter was increased and a commercial prototype was installed on an eight-inch natural-gas-transmission line, in series with an orifice meter run. Comparative data were obtained with an alternative method of measuring energy flow. This alternative method uses a flow computer with inputs from the orifice meter, a calorimeter, and a gravitometer. The energy flowmeter and flow computer tracked changes in energy flow. The energy flowmeter contains two main components. The first component is a flow separator which splits the flow into a main stream and a sample stream in constant proportion to the main stream. The second component burns the sample flow with a stoichiometric quantity of air. This stoichiometric flow is in direct proportion to the energy flow of gas in the main line. A method has been developed for laboratory testing of flow separators so that the ratio of main flow to sample flow can be accurately determined. Also, a field-prover apparatus was developed which can calibrate energy flowmeters.

252 (PB—87-218194/XAB) Improvement in TERRASCAN (trade name) instrumentation and techniques for location of buried pipe. Final report, January 1985-December 1986. Miller, R.C.; Attili, M.A.; Marston, P.G. (M/A-COM, Inc., Burlington, MA (USA)). Mar 1987. 139p. NTIS, PC A07/MF A01.

The rapid and accurate determination of underground-gas-distribution pipe continues to be a troublesome and costly problem for the gas industry. Electromagnetic pipe locators have been available to the gas industry for decades. However, this technology cannot locate plastic pipe without the use of a metallic locate wire or tape buried with the pipe. An instrument capable of locating underground plastic and metallic pipe reliably and quickly will ensure that excavations are made efficiently and safely by utility operators. A device of this type will also lead to a reduction in the frequency of accidental damage to buried utility lines. The current effort was preceded by many years of research by the Ohio State University (OSU) ElectroScience Laboratory which was underwritten initially by the Columbia Gas Service System, and then later by GRI. The current effort by M/A-COM was intended to refine the system developed by the OSU Electroscience Lab into a reliable, marketable device.

253 (PB—87-226031/XAB) Development of improved construction and maintenance equipment and techniques for accidental-damage prevention: completion of Phase 1. Topical report, August 1986-March 1987. Swanson, R.K. (Southwest Research Inst., San Antonio, TX (USA)). Apr 1987. 34p. NTIS, PC A03/MF A01.

The project aims to investigate an underground pipe location concept in which a small low-volume water-jet probe would replace bar holing as a final step in accurately locating and identifying underground pipe, including plastic gas pipe. The demonstration device consists of an instrumented probe with a small high-pressure water jet. The mechanical probing device demonstrated its effectiveness in penetrating compacted soils to average depths, in a few seconds. By using the jet to excite acoustic response from objects encountered, an operator can make direct identifications. Under good conditions, it is possible to differentiate between rock and plastic and steel pipe. Under the selected operating parameters, the jet will not damage plastic pipe. Phase I work indicates a Water Jet Pipe Identifier is feasible. Phase II will involve development of signal processing to identify unique acoustic signatures in the acoustic data generated by object encountered by the pipe identifier.

0340 Combustion

REFER ALSO TO CITATION(S) 625, 626, 655, 656

254 (PB—87-216008/XAB) Advanced heat-pipe heat exchanger and microprocessor-based modulating burner controls development. Annual report, January-December 1986. Lowenstein, A.; Cohen, B.; Feldman, S.; Spatz, M.; Smith, E. (TECOGEN, Inc., Waltham, MA (USA)). Mar 1987. 105p. (TE—4367-31-87). NTIS, PC A06/MF A01.

See also report for Jan 85-Jan 86 PB—86-203239.

The work presented in the report includes: (1) the development of a heat-pipe condensing heat exchanger; (2) the development of a nominal 100,000-Btu/hr modulating air/gas valve and (3) performance studies of a water/copper thermosyphon. The condensing heat exchanger uses ten water copper thermosyphons that are msnifolded at both the condenser and evaporator ends to achieve a low-cost, compact design. This work has met its objectives of producing a heat exchanger that could be integrated into a clamshell furnace raising its efficiency to +92 percent (steady state) with minimal impact on the furnace's dimensions.

255 (PB—87-223160/XAB) Advanced natural-gas-fueled-engine development. Part 2. Materials investigation. Final report, April 1985-July 1986. Kamo, R.; Walson, R.; Kamo, L. (Adiabatics, Inc., Columbus, IN (USA)). Nov 1986. 136p. (FR—8415-1186-PT-2). NTIS, PC A07/MF A01.

See also Part 1, PB—87-224804.

The program was undertaken in an effort to identify advanced materials and coatings capable of increasing the reliability and durability of valve-train components in an industrial-sized, natural-gas-fueled, reciprocating prime mover. Excessive valve-train wear was identified as the primary cause of frequent maintenance requirements for gas-fueled reciprocating prime movers. Promising material and coating candidates were subjected to laboratory friction wear testing, single-cylinder engine rig testing, and full-scale engine dynamometer testing on a Cummins GTA 855 for 300 hours. Metallics, CerMets, and monolithic and composite ceramics

were selected for evaluation. A cursory evaluation of low-friction piston ring and cylinder wall materials was also conducted. The results of this program suggest promise for the use of advanced materials as a means of improving the reliability and durability of the valve train of natural-gas-fueled reciprocating prime movers. Additional testing is required to generate more statistically significant data, and to establish greater confidence in the predictive capability of the test methods employed in this investigation.

256 **(PB—87-224804/XAB) Advanced natural-gas-fueled-engine development. Part 1: design and analyses. Final report, April 1985-July 1986.** Kamo, R.; Walson, R.; Kakwani, R.M.; Kamo, L. (Adiabatics, Inc., Columbus, IN (USA)). Nov 1986. 94p. (FR—8415-1186-PT-1). NTIS, PC A05/MF A01.

See also Part 2, PB—87-223160.

The objective of the research program was to design an advanced natural gas engine (NG 1990) to be produced in the 1990's which will have high thermal efficiency and 40,000 hours durability of the valve-train components before major engine overhaul. Preliminary design and feasibility of the NG 1990 advanced natural gas engine was completed. A natural gas engine simulation model predicts up to 43.6% brake thermal efficiency (5840 Btu/hp-hr BSFC) for the advanced engine with the advanced concepts like K-Miller cycle (early intake valve closing), lean burn combustion - A/F ratio = 24.5, high compression ratio up to 14:1, higher turbocharger efficiency of 63.2% overall, and axially stratified charge combustion system resulting in fast burning. The use of K-Miller cycle reduces the in-cylinder gas temperatures and allows engine operation at 14:1 compression ratio without knock tendencies. The design and analyses of the NG 1990 engine and its components like K-Miller system were completed in the program.

257 **(PB—87-224820/XAB) Catalytic radiant tube -- Phase 2. Proof of concept. Phase 3. Catalyst and tube evaluation. Annual report, February 1, 1986-January 31, 1987.** Tidball, R.K.; Kennedy, J.M.; Lannutti, J.J.; Schriber, R.J. (Alzeta Corp., Santa Clara, CA (USA)). Mar 1987. 69p. (ALZETA—87-722-135). NTIS, PC A04/MF A01.

See also PB—87-169835.

Phase 2 work was completed during the past year. Under the Proof of Concept testing, premixed natural gas and air was catalytially reacted on the inside surface of metal and ceramic tubes. The energy generated from combustion conducted to the outside tube surface and then was radiated and convected to the surrounding environment. Experimental results indicated that the activity of the platinum combustion catalyst decayed rapidly with time. Phase 3 work, Catalyst and Tube Evaluation, was initiated during the past year to explore the performance of a wider range of tube substrates and combustion catalysts than was tested under Phase 2. Experimental results from Phase 3 will be generated and analyzed later.

04 OIL SHALES AND TAR SANDS

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 23, 122, 263, 264, 265

258 **(BMFT-FB-T—86-254) Pilot test for the recovery of crude bitumen by injection of a modified CO/sub 2/-steam-mixture in the oil sands of the Ipiatik-East block/ Canada. Final report.** Nacke, L.; Grisogono, I. de. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Deminex-Deutsche Erdoelversorgungsgesellschaft m.b.H., Essen (Germany, F.R.)). Dec 1986. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753259/JAW.

The applicability of a new process for the recovery of crude bitumen shall be tested in the field. Three pilot patterns have been selected for stimulating the Canadian heavy oil reservoir Ipiatik-East with steam (base case) and with a steam/CO/sub 2/-mixture. In pattern 1, the first out of ten steam stimulation cycles has been completed. The production results confirmed the performance predictions. Currently, 2 wells are operating in the 2nd cycle and 5 wells are in the 3rd cycle. The pilot test provided fundamental information about: petrophysical reservoir parameters, matrix injectivity, fracture characteristics, steam and heat distribution and possibilities for optimizing the operating strategy. The cycle steam injection operations will be continued in order to extend the data base prior to commencing with steam/CO/sub 2/ injection. The results of the pilot test will contribute to enhance the heavy oil recovery in Canadian reservoirs. With 33 refs., 18 figs.

259 **(CTOM—870205) Numerical simulation of steam injection in bitumen and heavy oil reservoirs. Phase 1. Part 1.** (Toronto Univ., Ontario (Canada). Dept. of Chemical Engineering and Applied Chemistry). 5 Feb 1987. 89p. (MICROLOG—87-02761). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A sequential, iterative, fully implicit, one-dimensional, steamflood simulator is presented. The technique effectively divides the governing equations into two groups, which are iteratively solved in a sequential manner at each time step. It is shown that mass and energy balance errors can be maintained at extremely small levels using this technique. It is demonstrated in theory that for three-dimensional simulations of systems with several oil components, the sequential method potentially offers significant savings in computation time. However, this optimism is tempered with the observation that certain techniques which were used to speed the convergence of the one-dimensional simulator are likely to be considerably less successful in two and three dimensions. In the second part of the report, a procedure is presented by which the location of the steam front can be tracked with the purpose of improving the accuracy of the simulator. The velocity of the steam front, and several state variables at the steam front, are solved for directly from the governing equations. It is demonstrated that the front-tracking technique is able to reduce considerably spurious oscillations in state variables and injection rates as the steam front advances through the computational grid. Furthermore, evidence suggests that the front-tracking technique displays smaller truncation errors than does the method without front-tracking.

260 **(DOE/FE/60177—2437) Steam-oxygen combustion in asphalt ridge tar sand.** Romanowski, L.J. Jr.; Thomas, K.P. (Western Research Inst., Laramie, WY (USA)). Aug 1986. Contract FC21-83FE60177. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001545/JAW.

The in situ forward combustion process was evaluated using both air and steam-oxygen injection. Bench scale tube reactor experiments were conducted on Asphalt Ridge (Utah) tar sand to study the effects of the nitrogen or steam component in the injected gas on the oil yield, product oil quality, and process efficiency. Total-injected-gas and oxygen fluxes of 40 and 8 scf/h-ft^2, respectively, were similar during both combustion experiments. Regardless of the injected gas composition, the oxygen consumption rapidly approached 100% and the combustion process became self-sustaining at ignition temperatures of about 650 to 750°F (343 to 399°C). This was because the partial pressure of oxygen was identical for both experiments. A carbonaceous fuel was burned after ignition and the combustion temperatures increased to 1200 to 1800°F (649 to 982°C). Steam injection reduced coke formation, and the steam-char reaction further reduced the coke available for combustion in the steam-oxygen experiment. These mechanisms resulted in reduced fuel availability, less oxygen consumption, increased combustion zone velocity, and a slightly greater oil yield for the steam-oxygen test. The oil yield for the steam-oxygen combustion test was 67 wt % of the initial bitumen, which was slightly greater than that from the air-only experiment. Other beneficial effects of steam versus nitrogen during the combustion process were improved heat transfer, reduced differential pressures, and greater heating value of the product gas for the steam-oxygen test. 11 refs., 2 figs., 7 tabs.

261 **(DOE/MC/11076—2435) Laboratory evaluation of forward combustion in Sunnyside tar sand.** Johnson, L.A. Jr.; Romanowski, L.J. Jr. (Western Research Inst., Laramie, WY (USA)). Sep 1987. Contract FC21-86MC11076. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000912/JAW.

Three one-dimensional simulations of the in situ forward-combustion process using Sunnyside (Utah) tar sand were conducted to evaluate its effectiveness for recovering oil from the deposit. The injectant for these tests was either steam-oxygen, air-oxygen, or air. All three simulations experienced plugging of the reactor tube during the tests. Only the air test went to completion and produced 46 wt % of the bitumen as highly upgraded oil. The plugging problem in the tests is believed to result from the collection of a highly oxidized material in a cooler portion of the tube forming a semi-solid barrier. It is recommended that extensive thermal characterization studies be conducted on Sunnyside tar sand before further in situ studies are conducted. The work described here substantiates the need for extensive laboratory evaluation of a recovery process before field application. 18 refs., 2 figs., 3 tabs.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 60, 260, 261

262 **(DOE/FE/60177—2436) Mechanical characterization of Eastern reference oil shale.** Chong, K.P. (Western Research Inst., Laramie, WY (USA)). Sep 1987. Contract FC21-83FE60177. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000284/JAW.

Characterization of mechanical properties of Eastern oil shale is needed to provide information necessary for designing oil shale processes. This research contract was sponsored by Western Research Institute from December 1, 1986 to July 31, 1987, in a major effort to generate a much-needed database for characterization of Eastern reference oil shales. the following tasks have been completed: (1) A sophisticated and fully automated data acquisition and reduction system has been perfected with more than 1000 lines of written Basic code, involving a Keithley System 501 and Zenith Z-248 computer, interfacing with an Instron 1332 servo-hydraulic loading system, strain-gage instrumentation, LVDTs and other sensors. Manpower savings of 1500% are achieved with this automated system. (2) The following properties have been characterized: oil yields, M, as functions of specific gravities, rho; Young's Moduli, E, as functions of strain-rates and oil yields; Poisson's ratios, nu, as functions of strain-rates and oil yields; ultimate tensile strengths, σ/sub t/; ultimate compressive strengths, σ/sub u/; longitudinal wave velocities, v/sub p/; shear wave velocities, v/sub s/; and fracture toughnesses characterization (preliminary). 88 refs., 34 figs.

263 **Intrinsic kinetics of oxidation of residual organic carbon in rapidly pyrolyzed oil shale.** Fujimoto, F.D.; Braun, R.L.; Taylor, R.W.; Morris, C.J. (Lawrence Livermore National Lab., CA (USA)). *Energy and Fuels;* 1: No. 4, 320-323(Jul-Aug 1987).

The intrinsic kinetics of reaction of oxygen with carbonaceous residue in rapidly pyrolyzed Colorado oil shale were determined by a series of isothermal fluidized-bed experiments in the temperature range of 384-474 C. The char was produced from 100 l/Mg (24 gal/ton) oil shale by rapid heating to 530 C and isothermal pyrolysis for 5 min. The oxidation rate, determined by mass spectrometer measurements of evolved CO and CO_2, has second-order dependence on the unreacted char. The activation energy is 81.2 kJ/mol and the preexponential factor is 1.33 $s^{-1}Pa^{-1}$, assuming first-order dependence on oxygen. Rate measurements at temperatures higher than approximately 475 C are precluded by interference of CO_2 that is evolved from carbonate capture of SO_2. A lower heating rate during pyrolysis (i.e. a lower effective pyrolysis temperature) significantly decreases subsequent oxidation reactivity of char. 14 refs., 4 figs.

264 **Influence of weathering and low-temperature preoxidation on oil shale and coal devolatilization.** Khan, M.R. (DOE Morgantown Energy Technology Center, WV). *Energy and Fuels;* 1: No. 4, 366-376(Jul-Aug 1987).

The influence of preoxidation on the composition of oil shale and the yield of shale processing are not well-known. In this study, a western (Colorado) and an eastern (Kentucky) oil shale and their corresponding organic fractions (and a Pittsburgh seam coal, for comparison) were preoxidized under various conditions. Detailed pyrolysis behavior of these materials was subsequently determined by using techniques including thermogravimetric analysis combined with mass spectrometry (TGA/MS), microdilatometry, and Fourier transform infrared spectroscopy. The feedstock H/C atomic ratios, weight loss during pyrolysis, kerogen fluidity, and hydrocarbon product yield and quality are significantly reduced by preoxidation, while the yield of oxygenated products (H_2O, and CO_2) increased. These findings led to the hypothesis that preoxidation of oil shale organics introduces oxygen cross-linking bridges and/or reduces the aliphatic hydrogen content of the shale samples. The hypothesis was tested by Fourier transform infrared spectroscopy, which confirmed that preoxidation of the shale organics introduces oxygenated functional groups such as carbonyl and carboxylic while there is a marked reduction in the aliphatic hydrogen content of the samples. The results suggest that part of the oxygen functional groups undergo decomposition and evolve during subsequent pyrolysis as H_2O, CO_2, and heavier liquids at the expense of desirable hydrocarbon fuels and overall weight loss (conversion) during pyrolysis. 35 refs., 18 figs., 9 tabs.

0409 Waste Research And Management

265 **(DOE/FE/60177—2431) Physical, chemical, and toxicological characterization of untreated and treated tar sand wastewaters.** McTernan, W.F.; Hill, S.L.; Blanton, W.E. (Western Research Inst., Laramie, WY (USA)). Apr 1985. Contract FC21-83FE60177. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000292/JAW.

A study of the physical, chemical, and toxicological properties of untreated and treated tar sand wastewaters has been completed. One of the waters selected for this study, TS-1S wastewater, was generated during an in situ steam flood experiment conducted by the US Department of Energy. The other waters were generated during laboratory-scale extraction experiments that were designed to test high-pressure steam displacement and reverse combustion as processes for recovering oil from tar sand. One objective of this study was to evaluate the effectiveness of four treatment processes for reducing the contaminant load and toxicity of TS-1S wastewater. The treatment processes included: (1) ferric chloride coagulation, (2) ferric chloride coagulation plus activated carbon adsorption, (3) polymer-assisted flotation, and (4) polymer-assisted flotation plus activated carbon adsorption. According to the results of chemical analyses, the effluents generated by these treatment processes were very similar. However, polymer-assisted flotation plus activated carbon adsorption was most effective for reducing toxicity, whereas ferric chloride coagulation appeared to increase toxicity to at least one of the organisms tested. Thus, standard physicochemical analyses were not adequate indicators of the potential environmental hazards of TS-1S wastewater, as determined by toxicity testing. This study indicated that physical, chemical, and toxicological characterization is necessary to fully assess the potential environmental hazards of tar sand waters or any other chemically complex water. Another objective of this study was to expand the data base for tar sand wastewaters. 18 refs., 8 figs., 10 tabs.

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 960

0501 Reserves, Exploration, And Mining

266 **(INIS-BR—828) Distribution of uranium, thorium and potassium in the alkaline rocks of Pocos de Caldas massif.** Rocha, E.B. (Sao Paulo Univ. (Brazil). Inst. Astronomico e Geofisico). 1985. 150p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703724/JAW.

The Pocos de Caldas massif, with area about 800 Km/sup 2/ , represents the greatest complex of alkaline rocks existent in the American continent. Although values of U and Th are well Known in the mineralized areas, few has been registered with respect to the distribution of those elements outside the ore deposits. The rocks of the massif, in general, present high contents of U and Th when confronted with the surrouding country rocks. The distribution of the U and Th appoint a relevant additional data in the discussion on the hypotheais of nepheline syenites bodies formation in Pocos de Caldas by crystal fractionation processes. In this work are provided results of the U, Th and K distribution in the main petrographic facies occurring in the several studies places of the massif, yielded by gamma-ray spectrometric analysis of the samples. Those analysis disclose that khibinites present average values about 38 ppm U and 120 ppm Th; lujavrites, about 14 ppm U and more than 70 ppm Th; U-Th depleted nepheline synites, about 12 ppm U and 38 ppm Th, Th/U ratios are close to 3,0 in the nepheline syenites, about 3,7 in the phonolites, reaching values close to 4,0 in the khibinites. These values are comparable with others Th/U ratios of selected series of alkaline rocks reported in the international literature. Uranium and Th comparative data, attained by delayed neutron counting activation analysis also are given. The results obtained for the fluorimetric analysis show loss of U leaching is greater in the fine-grained rocks (phonolites) than coarse-grained ones (lujavrites, Khibinites). The autoradiographic studies reveal that radioactive elements are found concentrated in mineral phases. A new assessment of the radiogenic heat production is also available.

0504 Feed Processing

267 **(INIS-BR—695) Chloric lixiviation of the Itataia ore, Brazil.** Siqueira Leitao, J. de. (Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear). 1986. 31p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703455/JAW.

Aiming to develop an uranium extraction process from phosphates rocks of the Itataia region, Brazil, the lixiviation of this ore with chloric acid was studied. The ore solubilization for several concentrations of chloric acid is presented. During the lixiviation the agitation time and mass/volume ratio were fixed. (M.C.K.).

268 **(INIS-BR—730) Evaluation of alternatives for radium recovery of phosphogysum waste from chemical treatment of phosphatic ore.** Santos, J.A. dos. (Minas Gerais Univ., Belo Horizonte (Brazil). Escola de Engenharia). Dec 1986. 208p. (In Portuguese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE87703482/JAW.

The results from the research work undertaken to evaluate the economic recovery of the Itataia, Ceara phosphogypsum waste, obtained during the treatment of uranium bearing phosphatic ore are presented. The implications involved in the waste storage taking into account different aspects of environmental safety, are discussed. (M.A.C.).

0505 Uranium Enrichment

269 **(KFK—4267) Fabrication of microstructures with extreme structural heights by vacuum reaction injection molding and electroforming.** Vollmer, H.; Ehrfeld, W.; Hagmann, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernverfahrenstechnik). May 1987. 74p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753299/JAW.

Dissertation. Submitted by H. Vollmer.

Development work has resulted in a vacuum reaction injection molding (RIM) process which allows to fabricate plastic microstructures having minimum lateral dimensions in the micrometer range and structural heights of several hundred micrometers. The plastic structures generated by this method on an electrically conductive gate plate can be used directly as templates for the production of metallic microstructures through electroforming. The mold inserts for the molding tools used in the RIM process are fabricated by synchrotron radiation lithography and electroforming on an electrically conductive base plate. Particularly stable mold inserts made of one single material with extremely plane surfaces are obtained by electrodeposition of metal such that it stands by several millimeters over the resist structures generated by lithography. The mold insert produced in this way is separated from the base plate and the resist structures are subsequently removed. The molding tests were performed at a purpose developed vacuum RIM apparatus. Methacrylate base casting resins were used with an internal mold release agent added in order to reduce the adhesion of the produced part on the mold insert. By the example of fabrication of separation nozzle structures with minimum lateral dimensions of about 3 μm and a maximum structural height of 310 μm it has been demonstrated that molding can be performed at 100% yield and that service lives of the mold inserts can be achieved which are adequate for mass production.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 1300

270 **(DP-MS—87-83) Plutonium production in a remote cell.** Maddux, E.P.; Purcell, J.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 7p. (CONF-871101—65). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001375/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

Production of ^{239}Pu metal has traditionally been carried out in glovebox enclosures for protection of operating personnel and the environment. With the advent of more stringent federal regulations for protecting personnel, the environment, and security of special nuclear materials, it is proposed that plutonium be processed in a totally remote environment using automated work stations and robotic materials transfer and equipment maintenance. At the Savannah River Plant, the existing plutonium production facility is a batch-type glovebox operation built in the 1950s. A viable alternative to restoration of the existing glovebox operation is to provide a facility that uses remote cell operation.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 399, 2733

271 **(CEA-CONF—8584) Remote maintenance in TOR fast reactor fuel reprocessing facility.** Eymery, R.; Constant, M.; Malterre, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Nov 1986. 21p. (In French and English). (CONF-861102—47). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752687/JAW.

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

The TOR facility which is undergoing commissioning tests has a capacity of 5 T. HM/year which is enough for reprocessing all the Phenix fuel, with an excess capacity which is to be used for other fast reactors fuels. It is the result of enlargement and renovation of the old Marcoule pilot facility. A good load factor is expected through the use of equipment with increased reliability and easy maintenance. TOR will also be used to test new equipment developed for the large breeder fuel reprocessing plant presently in the design stage. The latter objective is specifically important for the parts of the plant involving mechanical equipment which are located in a new building: TOR 1. High reliability and flexibility will be obtained in this building thanks to the attention given to the integrated remote handling system.

272 **(CEA-CONF—8915) Simulation of spent fuel reprocessing processes: Realizations and prospects.** Boullis, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Dec 1986. 7p. (In French). (CONF-861289—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752682/JAW.

From International congress on data processing in chemical industries; Paris, France (8 Dec 1986).

The separation of uranium and plutonium in the Purex process is very complex and for the extension of reprocessing plants optimization of the process requires mathematical modelling. The development of this model is reviewed.

273 **(CEA-CONF—8916) Expert system for plant monitoring.** Jorda, A.; Souchet, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Dec 1986. 10p. (In French). (CONF-861289—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752698/JAW.

From International congress on data processing in chemical industries; Paris, France (8 Dec 1986).

The expert system developed to improve the monitoring of purification cycles in nuclear fuel reprocessing plants is biefly described and its adaptation to optimization in the chemical industry is considered.

274 **(DP-MS—87-11) Restoring solvent for nuclear separation processes.** Reif, D.J. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 17p. (CONF-871038—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000773/JAW.

From 5. symposium on separation science and technology for energy application; Knoxville, TN, USA (26 Oct 1987).

Solvent extraction separation processes are used to recover usable nuclear materials from spent fuels. These processes involve the use of an extractant/diluent (solvent) for separation of the reusable actinides from unwanted fission products. The most widely used processes employ tributyl phosphate as an extractant diluted with a normal-paraffin hydrocarbon. During use, the solvent is altered due to hydrolysis and radiolysis, forming materials that influence product losses, product decontamination, and separation efficiencies. In most processes, the solvent is recycled after cleaning. Solvent cleaning generally involves scrubbing with a sodium carbonate solution. Studies at the Savannah River Laboratory have shown that carbonate washing, although removing residual solvent activity, does not remove more solvent-soluble binding ligands (formed by solvent degradation), which hold fission products in the solvent. Treatment of the solvent with a solid adsorbent after carbonate washing removes binding ligands and significantly improves recycled solvent performance. Laboratory work to establish the advantage of adsorbent cleaning and the development of a full-scale adsorption process is described. The application of this process for cleaning the first cycle solvent of a Savannah River Plant production process is discussed.

275 **(ND-R—1346-D) Method for the gravimetric determination of plutonium in pure plutonium nitrate concentrate solution.** Mair, M.A.; Savage, D.J. (UKAEA Risley Nuclear Power Development Establishment). Dec 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752843/JAW.

Plutonium nitrate solution is treated with sulphuric acid before being heated and finally ignited. The stoichiometric plutonium dioxide so formed is weighed and hence the plutonium content is calculated.

276 **(RCM—03684e) Criticality accidents in a fuel reprocessing plant are equivalent to a nuclear explosion. Comment on the statement by Prof. Dr. Armin Weiss, University of Munich.** Baumgaertner, F. (Technische Univ. Muenchen, Garching (Germany, F.R.). Lehrstuhl fuer Radiochemie). Dec 1984. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753307/JAW.

The need for comment results from the fact that Prof. Weiss, endowed with the authority of a professor at the University of Munich, maintains that there could be a nuclear explosion, propagates this claim by an open letter, and that all the inhabitants of the districts adjoining Wackersdorf are concerned. The brochure points out the prerequisites for a substantial nuclear explosion, describes the consequences of a criticality accident in a fuel reprocessing plant, and looks into the background motives (scientific, private) for making such a claim.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 369, 914, 924, 1428

277 **(CEA-CONF—8814) Radioactive materials transport.** Ringot, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Apr 1986. 20p. (In French). (CEA-DAS—281; CONF-8604334—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752688/JAW.

From Parifeu-Intersecurite international agreement; Paris, France (24 Apr 1986).

After a brief review of transport regulations, the different types of packaging, transport hazards, intervention in case of accident and experience acquired are examined.

278 **(DOE/DP/00053—H1) DOE evaluation document for DOT 7A Type A packaging.** Edling, D.A.; Hopkins, D.R.; Williams, R.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). Mar 1987. Contract AC04-76DP00053. 288p. (MLM—3245). NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88001679/JAW.

This document, DOE Evaluation Document for DOT 7A Type A Packaging, March 1987, presents approximately 100 different packagings which have been determined to meet the requirements for a DOT Spec 7A Type A packaging (49 CFR 178.350) and satisfies the requirements of 49 CFR 174.315(a) concerning the requirements for a document.

279 **(DOE/OR/00033—T348) Sources of expertise in transportation planning, management, and operations: Information received as of September 25, 1987.** (Oak Ridge Associated Universities, Inc., TN (USA)). 1987. Contract AC05-76OR00033. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001411/JAW.

The DOE Office of Storage and Transportation Systems is responsible for the development and management of a transportation system to provide all the necessary services for the transportation of the spent fuel and wastes from reactor sites to repositories. DOE/ORO has requested Oak Ridge Associated Universities (ORAU) to assist DOE in developing rosters of sources of transportation expertise in: (1) carrier operations; (2) transportation management, planning, and logistics; (3) transportation equipment; (4) transportation facilities design and operation; (5) vehicle safety; and (6) transportation operations quality assurance; as related to truck, rail, barge, and intermodal transportation. Persons or organizations with experience in shipping of non-hazardous materials, spent nuclear fuel, other radioactive materials, and/or other hazardous materials were included in the information system. A mailed inquiry was sent to over 2300 potential sources of transportation expertise. Responses were received from 207 persons and 254 organizations. Section 1 contains the identification numbers of the individuals and organizations that responded. Section 2 contains identification codes, names, addresses, and phone numbers of each of the individual and organization respondents. The reader can refer to Section 2 for the name and address of the respondents for the identification codes listed for each technical area/experience base in Section 1.

280 **(MLM—3245-Add.1) DOE evaluation document for DOT 7A Type A packaging.** Edling, D.A.; Hopkins, D.R.; Williams, R.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). Mar 1987. Contract AC04-76DP00053. 215p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88001510/JAW.

This document is a support document for the "DOE Evaluation Document for DOT 7A Type A Packaging," MLM-3245, March 1987. Provided herein are details concerning the performance requirements specified in 178.350 Specification 7A, General Packaging, Type A. MLM-3245 references appropriate sections in this document. This document does not by itself meet the documentation requirements specified in 49 CFR 173.415 and has compliance value only when used in conjunction with MLM-3245.

281 **(MLM-MU—86-64-003) US Department of Transportation (DOT) Spec 7A Type A evaluation document: Spec 17C 55-gal steel drum with RWMC/SWEPP drum venting system carbon filter assembly.** Edling, D.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 15 Sep 1986. Contract AC04-76DP00053;AC07-76ID01570. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001598/JAW.

As part of MRC-Mound's responsibility to coordinate DOE Spec 7A Type A Packaging testing, evaluation, and utilization, this document evaluates per 49CFR 173.415(a) the SWEPP packaging system: DOT Spec 17C steel drums - 30, 55 and 83-gal; High Density Polyethylene (HDPE) liners; and SWEPP DVS Filter Assemblies (two configurations) as a US DOT Spec 7A Type A packaging. A variety of Type A performance testing was done on: DOT Spec 17C 55-gal steel drums; DOT Spec 17C 55-gal steel drums with HDPE liners; and DOT Spec 17C 55-gal steel drums with "Nucfil" filters as part of MRC-Mound's Type A Packaging Evaluation Program funded by DOE/HQ, DP-4, Security Evaluations. The subject SWEPP packaging incorporates modifications to the "Nucfil" filter and installation assembly previously tested in conjunction with the Spec 17C 55-gal drums. Thus, additional testing was required on the new filter installation in order to evaluate the entire packaging system. This document presents the test data to demonstrate the SWEPP packaging system's performance against the DOT 7A Type A requirements.

282 **(PNL-SA—14444) Thermal-hydraulic analysis of spent fuel storage systems.** Rector, D.R.; Wheeler, C.L.; Lombardo, N.J. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76RL01830. 24p. (CONF-870816—28). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000562/JAW.

From 24. national heat transfer conference and exhibition; Pittsburgh, PA, USA (9 Aug 1987).

This paper describes the COBRA-SFS (Spent Fuel Storage) computer code, which is designed to predict flow and temperature distributions in spent nuclear fuel storage and transportation systems. The decay heat generated by spent fuel in a dry storage cask is removed through a combination of conduction, natural convection, and thermal radiation. One major advantage of COBRA-SFS is that fluid recirculation within the cask is computed directly by solving the mass and momentum conservation equations. In addition, thermal radiation heat transfer is modeled using detailed radiation exchange factors based on quarter-rod segments. The equations governing mass, momentum, and energy conservation for incompressible flows are presented, and the semi-implicit solution method is described. COBRA-SFS predictions are compared to temperature data from a spent fuel storage cask test and the effect of different fill media on the cladding temperature distribution is discussed. The effect of spent fuel consolidation on cask thermal performance is also investigated. 16 refs., 6 figs., 2 tabs.

283 **(SAND—86-2802) Comparison of the IAEA unyielding surface to various yielding targets.** Gonzales, A. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 16p. (TTC—0708). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000245/JAW.

An experimental program was conducted to determine the effects of target characteristics on the structural response of radioactive material transport containers subjected to impact tests. A cylindrical half-scale model without any energy mitigating devices represented the impacting projectile. The models were impacted at different velocities in an end-on orientation into soil, concrete, and unyielding targets. As expected, the impact into an unyielding target resulted in damage to the unit that enveloped the deformation produced from the tests into the yielding targets. Only striking the 18-inch thick concrete runway at twice the impact velocity obtained from a 30-ft fall onto an unyielding target (88 ft/s vs. 44 ft/s) resulted in relatively similar cask damage. In the past, tests have been performed to qualify the severity of the unyielding target with respect to yielding surfaces. The British staged a spectacular train crash into a truck cask at an impact velocity of 100 mph. A German rail cask was dropped 66 ft and impacted a simulated asphalt roadbed at 45 mph. Sandia National Laboratories performed a series of crash tests involving a train colliding into a radioactive materials transport cask at 80 mph, and a cask on a railcar impacting into a concrete wall. All of these demonstrations resulted in cask damage that was less severe than obtained from the regulatory 30-ft drop onto an unyielding target. These tests provide an environment in which the energy absorbing capabilities of the vehicle structure interact with the hardness of the target. It must be emphasized that the complete description of an impact accident situation combines the impact velocity with the target hardness.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 845

0520 Waste Management

REFER ALSO TO CITATION(S) 276, 393, 406, 774, 792, 972, 1164, 1202, 1203, 1428, 1495, 1751, 1781, 1828, 1832, 1833, 1996, 2705

284 **(AD-A—183104/9/XAB) Selective dissolution and recovery of depleted uranium from armor plate. Final report, 26 June 1986-5 May 1987.** Czupryna, G.; Levy, R.D.; Gold, H. (Foster-Miller, Inc., Waltham, MA (USA)). 5 May 1987. 45p. (MER—0017-FMI-8644-80). NTIS, PC A03/MF A01.

The impacted armor targets used in testing high density armor-piercing ammunition containing depleted uranium (DU) are subject to disposal as low-level radioactive waste. Because of the costs associated with disposal of the entire armor plate and the limited use of secured commercial sites in the future, the U.S. Army is seeking to identify and evaluate new technologies for decontaminating these armor plates. The objectives of this Phase I SBIR program are two-fold, namely: to develop a selective solvent that can decontaminate impacted armor targets containing DU for disposal or recycle, and to identify and characterize technologies that can remove depleted uranium from the solvent for solvent recycle and uranium recovery for easier hazardous-waste disposal.

285 **(AERE-G—3983) Verification and validation of models, June 1985-May 1986.** Herbert, A.W.; Hodgkinson, D.P.; Jackson, C.P.; Lever, D.A.; Robinson, P.C. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Dec 1986. 24p. (DOE-RW—86.118). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752944/JAW.

The numerical accuracy of the computer models for groundwater flow and radionuclide transport that are to be used in repository safety assessment must be tested, and their ability to describe experimental data assessed; they must be verified and validated respectively. Also appropriate ways to use the codes in performance assessments, taking into account uncertainties in present data and future conditions, must be studied. These objectives are being met by participation in international exercises, by developing benchmark problems, and by analysing experiments. In particular the project has funded participation in the HYDROCOIN project for groundwater flow models, the Natural Analogues Working Group, and the INTRAVAL project for geosphere models.

286 **(AERE-G—4012) Notes on near field chemistry of radioactive waste disposal, a meeting held at Harwell on 26th/27th February 1986.** Wilkins, J.D. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.). Mar 1987. 13p. (DOE-RW—86.134; CONF-8602142—Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752955/JAW.

From Near field chemistry of radioactive waste disposal; Harwell, UK (26 Feb 1986).

The report summarises presentations made at a seminar on Near Field Chemistry of Radioactive Waste Disposal. An extensive bibliography is included.

287 **(AERE-R—12161) Initial appraisal of aspects of quality assurance in the conditioning of radioactive wastes. Part II - features of process modelling and quality control with particular reference to the cement-mixing and the grouting of ILWs.** Taylor, R.F. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Engineering Div.). Mar 1987. 49p. (DOE-RW—87.019). H.M. Stationery Office, London, price Pound5.00.

This Part II paper follows up the basic methodology on quality control and assurance measures set out in Part I of this study (AERE-R 11826). The main sections deal with general features of process modelling and quality control firstly for homogeneous ILWs mixed in-drum with cement, and secondly for heterogeneous solid waste ILWs immobilised by in-drum grouting. For the latter class of wastes the stream examined was chosen to be difficult in terms of wide variability of form. The methods outlined for dealing with this variability appear to offer satisfactory quality assurance without demanding excessive amounts of individual-package treatment and monitoring. The scheme might best be first considered in terms of application to moderately heterogeneous solid waste streams such as fuel cladding and hulls. It is recommended that the type of process control modelling outlined in the major tables of the paper is incorporated in the comprehensive quality assurance plans for individual waste streams and that they embody the kind of detailed process-sensitivity data exemplified within.

288 **(AERE-R—12231) Extension of NAMSOL to model the effect of rock-matrix diffusion.** Cherrill, T.P.; Herbert, A.W.; Jackson, C.P. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Feb 1987. 56p. H.M. Stationery Office, London, price Pound5.00.

Diffusion into the rock matrix is a very important retardation mechanism when considering the transport of radionuclides from an underground radioactive waste repository in a fractured hard rock. It is now possible to include this process directly in site-assessment models such as NAMSOL. The process of rock-matrix diffusion is briefly discussed and the implementation of an efficient and flexible finite-element model of it in NAMSOL is described. The model is used to perform one of the INTRACOIN test cases as a preliminary verification exercise, and the results are found satisfactory.

289 **(AERE-R—12331) Nirex safety assessment research programme: annual report for 1985/86.** Hodgkinson, D.P.; Cooper, M.J.; Atkinson, A. (UKAEA Atomic Energy Research Establishment, Harwell). Jan 1987. 109p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87752959/JAW.

The report describes progress of the Nirex Safety Assessment Research Programme in 1985/86. In addition, some background information is given on the overall programme and on the individual research projects, and likely future work is outlined. Research into the disposal of low-level waste (LLW) and intermediate-level waste (ILW) into underground repositories and onto the sea bed is reported. A large part of the programme is concerned with the effectiveness of near-field barriers to water-borne leakage of radionuclides from cementitious repositories. Considerable progress has been made with quantifying the longevity of steel containers and concrete structures, and the effectiveness of chemical constraints in limiting near-field concentrations. A range of techniques for measuring and modelling far-field phenomena has been developed and tested. Some initial studies have been performed to assess the durability of sea disposal packages and the behaviour of polythene in sea water.

290 **(AERE-R—12338) Seminar on long term research into liquid effluent treatment.** Hooper, E.W. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.). Feb 1987. 26p. (DOE-RW—86.129; CONF-8601128—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752953/JAW.

From Seminar on long term research into liquid effluent treatment; Harwell, UK (30 Jan 1986).

A one-day seminar on Long Term Research into Liquid Waste Treatment was held at Harwell on 30th January 1986. The seminar was sponsored by the Department of the Environment and was attended by ninety-five delegates representing industry, universities, DoE, CEGB and the AEA. The purpose of the meeting was to provide an opportunity for people working in the field of liquid effluent treatment to obtain up-to-date information on the nature and status of research being carried out in the United Kingdom. Nine presentations on research activity described work being undertaken on ultrafiltration and associated techniques, electrical processes and ion exchange. The presenters were from BNF, CEGB, Imperial College, University of Salford, University of Reading and from Harwell.

291 **(AERE-R—12507) Electrochemical ion-exchange for medium active liquid waste treatment. Annual progress report June-December 1986.** Bridger, N.J.; Turner, A.D. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Jan 1987. 4p. (DOE-RW—87.008). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752947/JAW.

Electrochemical ion-exchange has already been demonstrated to be a robust, effective process for the treatment of active liquid wastes, with high decontamination and volume reduction factors, and only a low energy requirement. The primary aim of this new programme is to scale up this process - initially to 0.1m³/h, and ultimately to 1³m/h. A new 0.4m² electrode module has been designed and constructed, together with 3m³ feed tanks for the first phase of this work. Further development work is also being carried out on alternative electrode designs and fabrication methods, as well as new exchange media (including inorganic absorbers and organic chelating resins) in order to optimize selectivity performance.

292 **(BMI/ONWI—609) Experimental and analytical studies of the thermal aspects of deep geologic disposal of commercial nuclear wastes.** Christensen, R.N.; Kulacki, F.A.; Keyhani, M.; Hsieh, S.S.; Osborne, R.; Keyhani, V. (Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering; Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Nov 1987. Contract AC02-83CH10140. 241p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88000132/JAW.

Effects of smooth and rough surfaces on an underground nuclear waste repository were studied using a rectangular duct to simulate thermal and hydraulic conditions at a nuclear waste repository. Experiments performed on smooth walls revealed that increasing the aspect ratio increases the air velocity, which leads to an increase in convective heat transfer coefficients and a decrease in the temperature difference between the air stream and the heated wall. The heated length required for fully developed heat transfer was also determined for various aspect ratios. In experiments involving rough walls, two surface roughnesses were characterized by the average height and the pitch-to-height ratio. A combination of two roughness heights and three pitches was constructed covering the ranges 0.088 to 0.12 and 2.0 to 4.7, respectively. A friction factor correlation was developed based on the velocity distribution and pressure drop measurements. Heat transfer data at the downstream end of the test section were correlated as a function of the Reynolds number. A heat momentum analogy was correlated using temperature and velocity distribution measurements. An approximate analytical solution through numerical analysis for correlating the Nusselt numbers at the downstream end of the test section was compared with corresponding experimental results. 47 refs., 105 figs., 33 tabs.

293 **(BMI/ONWI—635) Salt Repository Project Information Systems Description.** Rawles, B.A. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jul 1987. Contract AC02-83CH10140. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87012952/JAW.

This report provides a detailed description of the evolving integrated data management system that will meet the needs of the project during site characterization and the subsequent licensing process. Most components have been moved to the Digital Equipment Corporation VAX series of computers and to DM software. The information systems are designed to accommodate information

and data in many formats, but by utilizing common hardware and software, the users can access the system easily via menus and prompts. In addition, hard copy and microform backup are provided from the Technical Information Center, also described in this document.

294 **(BMI/ONWI—656) Microearthquake studies in the vicinity of the Cane Creek Potash Mine, Paradox Basin, Utah.** Wong, I.G.; Humphrey, J.R.; Silva, W.J. (Woodward-Clyde Consultants, San Francisco, CA (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Aug 1987. Contract AC02-83CH10140. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87014335/JAW.

For a 12-week period in 1984, a 5- to 9-station high-resolution network of analog and digital microearthquake recorders operated monitoring seismicity. The solution mine, previously a room-and-pillar mine located at an average depth of 1 km in the late-Paleozoic Paradox Formation, was undergoing a major brine extraction and refilling. The objective was to determine whether the seismicity previously observed in the vicinity of the mine by the Paradox Basin microearthquake network was associated with the mining activities. Several thousand events of two types were recorded: (1) events identical in appearance to tectonic microearthquakes that occurred throughout the region, and (2) unusual harmonic surface-wave-like events thought to be caused by the collapsing of a column of salt in the main shaft. 31 refs., 36 figs., 3 tabs.

295 **(BMI/ONWI—658) Quarterly brine migration data report, April-June 1985: Nuclear waste repository simulation experiments (brine migration), Asse Mine of the Federal Republic of Germany.** Eckert, J.L.; Kalia, H.N.; Coyle, A.J. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Sep 1987. Contract AC02-83CH10140. 264p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88000131/JAW.

The eighth brine migration data report describes experiments simulating a nuclear waste repository at the 800-m (2624-ft) level. This report desribes the test equipment, the Asse Salt Mine, and the pretest properties of the salt in the test gallery, and includes test data for 25 months of operations on brine migration rates, borehole pressure, salt temperatures, and thermomechanical behavior of the salt. 2 refs., 119 figs., 92 tabs.

296 **(CEA-CONF—8969) Characterization of whole assembly hulls produced by industrial reprocessing of LWR fuels.** Gue, J.P.; Isaac, M.; Hebel, W. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). Mar 1987. 7p. (CONF-870306—62). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752770/JAW.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The characterization program for Obrigheim and Stade PWR hulls sampled at La Hague was conducted in the CEA hot cells (Coquenstock program operating on whole assembly hulls). A description of the appearance of these hulls, recovered on the industrial scale and after severe damage, is followed by a review of the results of the different radiochemical characterization operations (neutron emission measurements, gamma scanning, alpha and mass spectrometry after dissolution of several samples, determination of the retention of tritium and other gaseous fission products occluded in the zircalloy clads etc). The alpha contamination of these hulls proved to be rather high, but it demonstrated that a large part (90 to 95%) was labile and could be removed by simple rinsing with cold 3N nitric acid. By contrast, contamination by fission products such as Cs 137, Ce 144 and Eu 154, remains high and relatively unaffected by nitriacid rinsing. Based on the results obtained and the observations recorded, an analysis is carried out of the origins of alpha contamination of these hulls treated on an industrial scale, among which the chief source is certainly the limited effectiveness of rinsing.

297 **(CONF-871101—30) Deterministic uncertainty analysis.** Worley, B.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE87011644/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

Uncertainties of computer results are of primary interest in applications such as high-level waste (HLW) repository performance assessment in which experimental validation is not possible or practical. This work presents an alternate deterministic approach for calculating uncertainties that has the potential to significantly reduce the number of computer runs required for conventional statistical analysis. 7 refs., 1 fig.

298 **(DOE/ID/12512—T2) Codisposal of diminimus levels of low-level radioactive waste and sanitary waste: Final report.** Chian, E.S.K.; Ghosh, S.B.; Kahn, B.; Giabbai, M.; Pohland, F.G. (Georgia Inst. of Tech., Atlanta (USA)). Feb 1986. Contract FG07-84ID12512. 239p. (SCEGIT—86-101). NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE87014506/JAW.

Codisposal of low-level radioactive waste (LLRW) with municipal refuse was investigated in two pilot-scale controlled concrete lysimeters; 3.05 m x 3.05 m x 4.28 m that were lined with 0.762 mm (30-mil) HDA Gundline liner, elastomeric polyolefin alloy based high density polyethylene, and had provisions for leachate collection and recirculation. Shredded municipal refuse was placed within the landfills and spiked with radionuclides (Co-58, Sr-85, and Ce-141) at a level of 28 nCi/gm to simulate codisposal of LLRW with municipal refuse. Water was added to simulate normal rainfall events; the extent to which radionuclides and organics were leached from both landfills was recorded. To compare the effect of leachate recirculation on the indicator parameters, leachate recycle was practiced in one of the landfills, while the other was operated as a single-pass system. Analyses on leachate samples, collected from both landfills, included detection of Co-58, Sr-85, and Ce-141 along with pH, ORP, conductivity, total alkalinity, COD, BOD_5, TOC, volatile fatty acids (acetic, propionic, isobutyric, butyric, and valeric), sulfide, chloride, iron, manganese, zinc, nickel, and cobalt. 113 refs., 47 figs., 23 tabs.

299 **(DOE-PW—87.021) Direct disposal of spent nuclear fuel. The current status of technology January 1987.** Wheelton, I.S.; Kelly, B.R.; Wood, E. (Department of the Environment, London (UK)). Feb 1987. 129p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752942/JAW.

The study assesses the degree and status of research and development worldwide on direct disposal of spent nuclear fuel. It is limited to technological, radiological and waste management aspects appertaining to light water and AGR reactor systems and reviews the state of the art in terms of applicability to the United Kingdom. The report concludes that much technology exists both at national and international level which the UK can apply to the subject of direct disposal.

300 **(DOE-RW—87.022) Chemical modelling studies in support of radiological risk assessments of radioactive waste disposal 1984-86.** Read, D.; Williams, D.R. (Department of the Environment, London (UK)). Dec 1986. 86p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87752941/JAW.

This report describes the testing of computer programs identified as being capable of modelling chemical processes in radioactive waste disposal systems. The functions, limitations and data requirements of the programs assembled at UWIST are discussed and the organisation of an extensive thermodynamic database compiled to support the codes described. The role of chemical models in DoE probabilistic radiological assessment (PRA) methodology, is outlined. Their potential for radiological assessment purposes has been addressed through a series of case studies on existing and potential low- and intermediate-level radioactive waste disposal sites. Results to date suggest them to be capable of fulfilling their intend-

ed role within the constraints of model assumptions. A number of collaborative projects designed to verify, validate and improve the models have been established.

301 **(DOE/RW—0038-Update-5/87) Information services directory.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). May 1987. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87010823/JAW.

This Directory will facilitate dissemination of information. It is a reference document that lists the sources of program information available to the states, Indian Tribes, and the public. Chapter 1 describes current program information sources produced by OCRWM and by DOE's Office of Scientific and Technical Information (OSTI). Chapter 2 provides a directory of OCRWM and DOE technical information, and includes descriptions of computerized data bases and other resources. Chapter 3 is an index of OCRWM Headquarters and Project Office contacts, as well as state and Indian Tribe contacts. Chapter 4 enumerates Congressional Committees and Subcommittees that have jurisdiction over various components of the Civilian Radioactive Waste Management Program, and Chapter 5 lists DOE reading rooms, as well as information offices and the public libraries in affected states that are on one or more of OCRWM's mailing lists.

302 **(DP-MS—87-58) New low-level radioactive waste disposal/storage facilities at the Savannah River Plant: Performance assessments.** Sutherland, A.A.; Grant, M.W.; Cook, J.R. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA); Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 16p. (CONF-870859—15). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014835/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Savannah River Plant will soon begin construction of a new facility for the disposal and storage of low-level radioactive waste. Initial planning for the facility included performance assessments of possible disposal technologies. The determination of input parameters and the interpretation of the results provided valuable insight into the process of performance prediction. Factors such as leach mechanisms and solubility controls of migrating species required particularly careful evaluation. 12 refs., 3 tabs.

303 **(DP-MS—87-90) Low level radioactive waste disposal/treatment technology overview: Savannah River site.** Sturm, H.F. Jr. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014832/JAW.

The Savannah River Site will begin operation of several low-level waste disposal/treatment facilities during the next five years, including a new low-level solid waste disposal facility, a low-level liquid effluent treatment facility, and a low-level liquid waste solidification process. Closure of a radioactive hazardous waste burial ground will also be completed. Technical efforts directed toward waste volume reduction include compaction, incineration, waste avoidance, and clean waste segregation. This paper summarizes new technology being developed and implemented. 11 refs., 1 fig.

304 **(EPRI-NP—5365-M) Designs and costs of low-level waste disposal facilities: Interim report.** Baird, R.D.; Rogers, V.C.; Shuman, R.; Sutherland, A.A.; Owen, D.H. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 66p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920034/JAW.

A comprehensive classification system for low-level radioactive waste disposal technologies is described, and the application of the classification system to currently available LLW disposal technologies is illustrated. The applicability of statutory requirements to LLW disposal technologies other than shallow land disposal is discussed. Examples of conceptual designs together with the design basis are presented for buried placement (traditional name is shallow land disposal), covered structure (above-ground vault disposal), buried structure (below-ground vault disposal), buried modules (modular concrete canister disposal), covered modules colocated with buried structure (earth mounded concrete canister disposal), and deep structure (mined cavity disposal). The methodology for estimating quantities of material, equipment, and manpower is discussed, and cost estimates for the six generic disposal technologies are presented. Worker exposure rates are estimated for the conceptual disposal technologies. Finally, available modeling tools for predicting radiological performance are evaluated for their applicability to the six conceptual disposal technologies. 28 refs., 7 figs., 3 tabs.

305 **(FLPU—84-14) Determination of the geotechnical properties of mudrocks from geophysical logging of the Harwell boreholes.** Horseman, S.T.; McCann, D.M.; McEwen, T.J.; Brightman, M.A. (British Geological Survey, Keyworth. Fluid Processes Research Group). Nov 1984. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752845/JAW.

The geotechnical properties of mainly argillaceous strata at depth in borehole HW3 at Harwell, Oxfordshire have been determined using a variety of borehole geophysical logging techniques. The aim of this work was to assess the usefulness of such techniques for the indirect measurement of the geotechnical properties of the rocks and the subsequent bearing that such knowledge would have on the design of a site investigation programme for the deep disposal of non heat emitting radioactive waste. The borehole was logged by Seismograph Services Ltd over the interval from 165 - 551 m., whilst open and mud filled. Seven different geophysical logs were run: caliper, formation density, neutron-neutron, natural-gamma, 3D velocity, spontaneous potential, single point resistance and 16"/64" normal resistivity. The logs that were of any use in determining geotechnical properties were the neutron-neutron, the formation density and the sonic log. It is suggested that in these types of formation the sonic log, once calibrated for the particular circumstances, could be used to provide a useful downhole strength log.

306 **(FLPU—85-13) Long term effects on potential repository sites: the alteration of the Lower Oxford Clay during weathering.** Milowdowski, A.E.; Bloodworth, A.J.; Wilmot, R.D. (British Geological Survey, Keyworth. Fluid Processes Research Group). Sep 1985. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87752838/JAW.

The report is one of a short series describing work carried out to investigate the long-term effects of various geological processes on the performance of both shallow and deep repositories for low and intermediate-level radioactive wastes. This paper deals with the alteration as a result of weathering of the Lower Oxford Clay, a potential host rock for shallow disposal of wastes. A description of the Lower Oxford Clay is given, along with the weathering of argillaceous rocks. Investigations of the weathering at the Elstow Storage Depot are described, as well as the implications for radioactive waste disposal. (U.K.).

307 **(FLPU—86-7) Measurement of the vertical component of hydraulic conductivity in single cased and uncased boreholes.** Black, J.H.; Noy, D.J.; Brightman, M.A. (British Geological Survey, Keyworth. Fluid Processes Research Group). Nov 1986. 56p. (DOE-RW—86.126). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87752943/JAW.

The project summarised in the paper aimed to assess the different existing methods of measuring vertical hydraulic conductivity in single boreholes by carrying out some actual field testing. The measurements are relevant to the disposal of radioactive waste into argillaceous rocks, where the primary geological barrier to potential leachate migration is the mudrock. Also the prime parameter of interest in the assessment of mudrocks is the vertical component of hydraulic conductivity. A description of the methods of test analysis and interpretation is given. The experimental programme for open borehole testing and cased borehole testing is described, along with the practical and theoretical considerations.

308 **(HEDL—7640) Environmentally assisted cracking mechanisms in repository environments.** Mills, W.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76FF02170. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014375/JAW.

This paper assesses how environmentally assisted cracking (EAC) mechanisms in candidate container materials can be identified to enhance the accuracy of long-term projections of performance in the repository. In low and intermediate strength steels, the role of the two principal mechanisms, slip dissolution/film rupture (SD/FR) and hydrogen embrittlement (HE), is a very complex and controversial issue. No unanimity exists concerning the operative cracking mechanisms, and there is no unique or rigorous approach that would be persuasive in selecting an appropriate model. Both of the proposed mechanisms have common rate controlling processes such as surface adsorption rate, passivation rate, and oxidation rupture rate, which makes it difficult to identify the operative mechanism. Development of a quantitative model for predicting environmental effects for low-carbon steels in repository environments would provide a theoretical basis for assuring the long-term structural integrity of waste-package containment. To date, only one quantitative model has been developed. The agreement between predicted and observed behavior suggests that SD/FR processes control the environmental acceleration in crack growth rates for this class of materials. Deviations from predicted behavior due to HE effects should be uncovered experimentally. 59 refs., 4 figs., 4 tabs.

309 (IAEA-TECDOC—418, pp 151-175) **Investigation of spent fuel element cladding in the storage basin of a WWER research reactor.** Schiller, R.; Nyikos, L.; Pajkossy, T. (Central Research Institute for Physics, Budapest, Hungary). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

In this study a complex investigation of mechanical and chemical integrity of aluminium spent fuel cladding under long-term wet storage conditions was undertaken. Experimental results were used for the elaboration of the principle model on aluminium corrosion and for formulating practical recommendations. 5 references, 10 figures, 3 tables.

310 (IAEA-TECDOC—418, pp 177-180) **Oxidation of zircaloy cladding in air.** Kawasaki, S.; Suzuki, M. (Japan Atomic Energy Research Institute, Tokai, Ibaraki). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

Results of simulating experiments on LWR spent fuel cladding oxidation in air are presented. Zircaloy-4 tubes were exposed in air under the temperatures between 250 and 500 deg. C; the rate of oxidation as a function of temperature and time and crystallographic structure of oxides were investigated as well as the effect of salt on the oxidation behaviour of Zircaloy at 400 and 500 deg. C. 2 references, 4 figures, 1 table.

311 (IAEA-TECDOC—418, pp 181-190) **Effect of gamma radiation on metal corrosion under spent fuel storage conditions.** Alexandrov, A.B.; Sedov, V.M.; Nechaev, A.F.; Petrick, N.G.; Kalyazin, N.N.; Filippov, E.M. (All-Union Project and Research Institute of Complex Power Technology, Leningrad, USSR). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

It is shown that γ-radiation accelerates corrosion of stainless steel and other metals in water and humid air under the conditions simulating spent nuclear fuel storage. Discussion of the observed radiation effects is presented. 4 references, 7 figures, 2 tables.

312 **(IAEA-TECDOC—418) Long term wet spent nuclear fuel storage. Proceedings of a technical committee meeting on behaviour of used fuel assemblies and storage equipment at long term wet storage conditions, held in Leningrad, USSR, 26-30 May 1986.** (International Atomic Energy Agency, Vienna (Austria)). Apr 1987. 233p. (CONF-8605147—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW.

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

The meeting showed that there is continuing confidence in the use of wet storage for spent nuclear fuel and that long-term wet storage of fuel clad in zirconium alloys can be readily achieved. The importance of maintaining good water chemistry has been identified. The long-term wet storage behaviour of sensitized stainless steel clad fuel involves, as yet, some uncertainties. However, great reliance will be placed on long-term wet storage of spent fuel into the future. The following topics were treated to some extent: Oxidation of the external surface of fuel clad, rod consolidation, radiation protection, optimum methods of treating spent fuel storage water, physical radiation effects, and the behaviour of spent fuel assemblies of long-term wet storage conditions. A number of papers on national experience are included.

313 (IAEA-TECDOC—418, pp 11-24) **Experience from operation of the Swedish Central Intermediate Storage Facility.** Brundin, B.; Vogt, J. (OKG AB, Figeholm, Sweden; Swedish Nuclear Fuel and Waste Management Co., Stockholm). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

Svensk Kaernbraenslehantering AB, SKB (Swedish Nuclear Fuel and Waste Management Company), which is owned by the four nuclear power utilities in Sweden, has been given the assignment to develop, plan, build and operate facilities and systems for the management and disposal of spent nuclear fuel and radioactive waste from Swedish nuclear power stations. Each year about 250 metric tons of spent nuclear fuel are generated in 12 Swedish reactors and must be disposed of. The fuel is first stored for at least one year at the reactors, whereupon it is transported for central intermediate storage in the CLAB facility (CENTRAL STORAGE FACILITY FOR SPENT FUEL). The Swedish system for the management and disposal of spent nuclear fuel is based on intermediate storage in water pools for 30-40 years, prior to final disposal. CLAB was taken into active operation July 11, 1985, when the first spent fuel arrived. During the first so-called Nuclear Trial Operation Period, operating routines and procedures as well as all systems have been tested and verified under active conditions. The results have been very satisfactory and receiving capacity was as originally planned. Between July 1985 and May 1, 1986, 68 fuel transport casks with an equivalent of 201 metric tonnes of uranium and 13 casks with core components have been received. 9 figures.

314 (IAEA-TECDOC—418, pp 25-38) **Spent fuel storage development in the USSR.** Kondratyev, A.N.; Kurnosov, V.A.; Kiyko, I.E.; Rybalchenko, I.L.; Spichev, V.V.; Suhoruchenkov, M.N.; Tikhonov, N.S. (All-Union Project and Research Institute of Complex Power Technology, Leningrad, USSR). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

This paper deals with the main types of NPPs developed for nuclear energetics of the USSR, some characteristics of the main types of spent nuclear fuel and storage arrangement principles. Handling technology for spent nuclear fuel storage is described and problems of spent fuel storage safety are discussed. 15 references, 4 figures, 1 table.

315 (IAEA-TECDOC—418, pp 39-45) **Experience in wet storage and prospects of spent fuel management in Czechoslovakia.** Machacek, V.; Rajman, I.; Vlcek, K.; Duris, J.; Kmosena, J.; Ziman, V. (Ceskoslovenska Komise pro Atomovou Energii, Prague; Federalni Ministerstvo Paliv a Energetiky, Prague, Czechoslovakia; Atomova Elektraren Bohunice, Jaslovske Bohunice, Czechoslovakia). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

An information concerning the 7 years' operation of the at-reactor spent fuel pool is given in a survey of pool chemistry, radiochemistry, and operational data as investigated and observed under normal conditions and during spent fuel discharge from reactor refuelling. The performance of the water treatment system is described and the envisaged improvement of its efficiency by inclusion of an inorganic sorbent selective for caesium ions is outlined. An assumed scenario shows the envisaged provisions feasible to solve the problem of spent fuel management as required for twelve WWER-440 power reactor units constituting the near-term programme of nuclear power development in Czechoslovakia. It also comprehends an away-from-reactor storage facility with a capacity of 600 t U going to be put into operation this year. 2 references, 4 figures.

316 (IAEA-TECDOC—418, pp 47-57) **Wet storage in the USA: recent experience and directions.** Johnson, A.B. Jr.; Bailey, W.J.; Klein, K. (Pacific Northwest Lab., Richland, WA; DOE Office of Civilian Radioactive Waste Management, Washington, DC). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

Wet storage has been the only licensed option for spent fuel management for U.S. commercial power reactor operators, except for a period of commercial reprocessing at the Nuclear Fuel Services facility, 1965-71. Developments are underway to bring dry storage to licensed status in the U.S. by mid-1986. However, wet storage will remain the predominant storage method, at least beyond the turn of the century. The Nuclear Waste Policy Act of 1982 establishes current U.S. policy regarding responsibilities for spent fuel management. The Nuclear Waste Confidence Rulemaking proceedings address the viability of extended wet storage for U.S. reactors. U.S. utilities have moved aggressively to implement optimized utilization of wet storage technology, assisted in some areas by federal programs. This paper summarizes U.S. policy and regulatory aspects of wet storage and the status of several wet storage technology developments, including: dense racking; double tiering; credit for burnup in rack designs; transshipment; impacts of extended burnup; rod consolidation and pool decommissioning. 14 references, 1 figure, 4 tables.

317 (IAEA-TECDOC—418, pp 59-64) **Spent fuel storage under wet conditions. A review of the Indian experience.** Prasad, A.N. (Bhabha Atomic Research Centre, Bombay, India). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

The nuclear fuel used in the thermal reactor systems operated so far in India is essentially of three types - the aluminium clad uranium metal fuel from the research reactors, the zircaloy clad uranium oxide fuel assemblies of the BWR type and the zircaloy clad uranium oxide fuel assemblies of the PHWR type. Over the years considerable experience has been gathered in the wet storage of spent fuel discharged by these reactors. The paper reviews the behaviour of the spent fuel under conditions provided by various storage facilities at-reactor and fuel reprocessing plants.

318 (IAEA-TECDOC—418, pp 65-73) **Compact spent fuel storage in Hungary.** Lorand, F. (Eroemue es Halozattervezoe Vallalat, Eroeterv, Budapest, Hungary). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

The reasons, main philosophy and technological and safety approaches to compact spent fuel storage in water pools are presented. Practical application of elaborated concept will allow to double the capacity of at-reactor spent fuel storage pools.

319 (IAEA-TECDOC—418, pp 75-83) **Irradiated nuclear fuel storage at the Sellafield (UK) reprocessing plant.** Addison, C.W.E.; Shaw, R.D. (British Nuclear Fuels Ltd., Sellafield). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

British Nuclear Fuels plc (BNFL) provides a comprehensive range of fuel services to the operators of nuclear power plants. Reprocessing of spent fuels is carried out at BNFL's Sellafield plant in Cumbria in the north west of England. To date, over 25,000 te of fuel from the first generation of power reactors in the UK - the so-called Magnox reactors - have been reprocessed. Construction of a major new facility for the reprocessing of oxide fuels, referred to as THORP (Thermal Oxide Reprocessing Plant), is now underway. The Magnox fuel, which is in the form of uranium metal rods within a magnesium alloy can, is held in the reactor pond for at least 90 days before delivery to Sellafield for further storage before reprocessing. The conditions under which Magnox fuel is stored have evolved in the light of operating experience and of laboratory based and full scale development work. As a result of this research and development activity, fuel will be kept in ullaged containers in water dose to pH 13 with low Cl^- and SO_4^{2-} levels. The oxide fuels currently arriving on the site for storage prior to reprocessing in the THORP plant are considered in two separate categories: the stainless steel clad fuels from the second generation of UK nuclear power reactors, and the fuels from water cooled/water moderated reactors (LWR) which are generally clad in a zirconium alloy. After an initial cooling period in the reactor site ponds, AGR fuels are currently stored at Sellafield in containers generally in demineralised water. Studies of alternative storage water chemistry have been carried out to ensure a capability to provide satisfactory storage of the fuel until scheduled reprocessing. The condition of AGR fuels after periods of wet storage has been studied routinely using both non-destructive and destructive (metallographic) methods.

320 (IAEA-TECDOC—418, pp 85-96) **Advanced technologies in spent fuel receiving and pool storage.** Bonnet, C.; Baillif, L. (Societe Generale pour les Techniques Nouvelles S.G.N., 78 - Saint-Quentin-en-Yvelines, France). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

A description of spent fuel handling and storage concept at La Hague industrial scale reprocessing plants (UP2-800 and UP-3) is presented, including the design of special storage baskets which allow to achieve optimal storage capacity, design and main principles of the work of heat exchangers and pool water treatment units and other improvements which were made in order to increase safety, reliability, seismic resistance and automation. 7 figures.

321 (IAEA-TECDOC—418, pp 97-105) **Surveillance of the behaviour of spent fuel assemblies at long-term wet storage conditions at Olkiluoto Power Plant site.** Salo, J.P.; Vitikainen, E. (Imatran Voima Oy, Helsinki, Finland; Valtion Teknillinen Tutkimuskeskus, Espoo, Finland). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

Industrial Power Company Ltd (TVO) operates two boiling water reactor units of ASEA-ATOM design at Olkiluoto, southwestern Finland. TVO has prepared a programme for management of spent fuel in the future as required by the decision in principle of the Finnish Government. The long-term wet storage is part of the programme. An interim storage facility, TVO-KPA-STORE, is being built at Olkiluoto. According to the timeschedule the first phase of the facility will be completed in December 1987. The first part of this paper describes briefly the design criteria and structure of the interim storage facility. Also the storage and fuel inspection equipment to be used will be presented. The second part of the paper deals with the spent fuel surveillance aspects: execution of the spent fuel surveillance programme in the TVO-reactor pools and outlines for the surveillance programme in TVO-KPA-STORE to be taken into use in the future. 6 references, 2 figures, 1 table.

322 (IAEA-TECDOC—418, pp 107-110) **Storage of the HWRR low burn-up fuel.** Chun Yuquing, Y.C. (Institute of Atomic Energy, Beijing, China). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

In this study the general approach, safety aspects and technological procedures of handling, testing and storage of the fuel from Heavy-Water Research Reactor are described. Some analytical data of the storage pool's water are presented. 1 figure, 1 table.

323 (IAEA-TECDOC—418, pp 113-121) **Behaviour of RBMK spent fuel assemblies in water cooled pools.** Varovin, I.A.; Eperin, A.P.; Nikiforov, S.A.; Shevchenko, V.G.; Bochkareva, S.N.; Konstantinov, E.A.; Nesterenko, A.P.; Sedov, V.M.; Senin, E.V. (Leningrad Nuclear Power Plant, USSR; All-Union Project and Research Institute of Complex Power Technology, Leningrad, USSR). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

This paper deals with spent fuel storage reliability in cooling pools. The behaviour of spent fuel assemblies with burn-up from 1686 to 18,720 MWd/tU and with 8-year storage period is studied. Assessments of corrosion rate values for spent fuel assembly structural materials in pool storage are made. The mechanical properties in storage are found to be practically unchanged. It is shown that corrosion products deposition on fuel assembly surfaces is the source of radioactive contamination of the pool. Conclusion is made that spent fuel long-term storage in cooling pools and reuse of underirradiated fuel assemblies in RBMK reactors are possible. 13 references, 2 figures, 2 tables.

324 (IAEA-TECDOC—418, pp 123-130) **Spent fuel storage alternatives for a WWER-440 unit.** Takats, F. (Eroemue es Halozattervezoe Vallalat, Eroeterv, Budapest, Hungary). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

General information on the fuel manipulation systems of a WWER-440 type reactor is given as well as a description of the system for 3 year at-reactor fuel storage. Description of the away-from reactor fuel storage building for 5000 spent fuel assemblies is presented. Prior to establishing this storage facility the storing capacity of the NPS spent fuel pools has been doubled by their reconstruction. An account is given of the research carried out during the design of the compact storage system.

325 (IAEA-TECDOC—418, pp 131-141) **Experience with the storage of spent fuel of WWER-type reactors.** Veretennikov, G.A.; Ignatenko, E.I.; Reznik, A.A.; Litvinov, A.N.; Ananyev, E.P. (Ministerstvo Ehnergetiki i Ehlektrofikatsii SSSR, Moscow). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

The USSR electric power industry widely uses nuclear power plants (NPPs) with high capacity pressurized water reactors (WWER-type reactors). Since 1964, when WWER-210 (210 MWe gross electrical output) reactor was commissioned, several reactor generations have been developed. WWER-440 and WWER-1000 reactors have been successfully operated for many years. In this period reactor building technology in the USSR and abroad has made tremendous success, unique in the history of electric power development. The operation of a large number of high capacity NPPs requires the development of a spent nuclear fuel management system to handle spent fuel containing high levels of radioactivity. The development of spent nuclear fuel handling techniques is as important as the construction and operation of NPPs. The report addresses some results of experience with spent nuclear fuel (SNF) handling, SNF storage in at-reactor storage pools and SNF shipment from a NPP, the latter being part of post-reactor fuel cycle though not a major one. 4 references, 5 tables.

326 (IAEA-TECDOC—418, pp 143-150) **Evaluation of the integrity of the pool components by the concentration of the corrosion products in the spent fuel storage pool water.** Okamoto, H.; Ochiai, K.; Todokoro, A.; Kaneko, H.; Takeda, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo, Japan). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

In this study it is proposed to use a periodical analysis of corrosion products (mainly Fe, Ni and Cr) concentration in storage pool water for evaluation of the integrity of pool components. The methods of measurements and results are described. 1 reference, 6 figures, 2 tables.

327 (IAEA-TECDOC—418, pp 191-198) **Radiation protection aspects of wet storage of spent nuclear fuel.** Wiktorsson, C.; Godas, T. (National Institute of Radiation Protection, Stockholm, Sweden). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

Spent nuclear fuel from Sweden's twelve light water reactors is stored in water pools. Experience of water storage has been gained since the early 1970s when the first Swedish nuclear power plant was put into operation. The waste policy in Sweden is based on the fact that the fuel will be finally disposed of in rock without reprocessing. Different methods for final disposal have been discussed and one method (KBS-3) has been judged by the government to fulfil the requirements for radiation protection and nuclear safety stipulated in the act of nuclear activities. Before final disposal, the fuel will be transfered from the reactors to a central intermediate storage. This storage named CLAB is situated at the Simpevarp site close to the Oskarshamn Nuclear Power Plant. The CLAB storage facility was put into active operation in the middle of 1985 after approval by the Nuclear Power Inspectorate and the National Institute of Radiation Protection (NIRP). Radiation protection aspects are the responsibility of the NIRP. Questions of concern in the review of the final safety analysis by NIRP were factors influencing occupational radiation protection, releases of radioactive material from the different stages of operation and incidents. The principles on which the approval was based, including factors of interest from the radiation protection point of view, will be discussed in the paper. 3 references, 2 figures.

328 (IAEA-TECDOC—418, pp 201-208) **Summary of the third international spent fuel storage symposium/workshop, held in Seattle, Washington, USA, 8-10 April 1986.** Johnson, A.B. Jr. (Pacific Northwest Lab., Richland, WA). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

The Third International Spent Fuel Storage Symposium/ Workshop had two topics: dry storage and rod consolidation, focusing principally on light-water reactor (LWR) fuel. The meeting had three formats: a two-day symposium, a poster session, and a one-day workshop. There were 207 attendees from 14 countries. The meeting was sponsored by the U.S. Department of Energy's Office of Civilian Radioactive Waste Management and the Richland Operations Office and was organized by the Pacific Northwest Laboratory, with assistance from DWK (FRG), EPRI, Ontario-Hydro, and the IAEA. 3 tables.

329 (IAEA-TECDOC—418, pp 209-224) **Summary of the March 1986 IAEA advisory group meeting on spent fuel management.** Colton, J.P. (United States Arms Control and Disarmament Agency, Washington, DC). Apr 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88700183/JAW. (CONF-8605147—).

From IAEA coordinated research program meeting on behavior of spent fuel assemblies in extended storage (BEFAST); Leningrad, USSR (26 May 1986).

Overview of the purposes, results and recommendations of the IAEA Advisory Group Meeting held in March 1986 is presented, including brief analysis of the world spent fuel management situation, state-of-the-art of national programmes in Argentina, Belgium, Czechoslovakia, France, Federal Republic of Germany, Japan, Sweden, Switzerland, UK and USA, and plans of IAEA meetings for 1987-1988.

330 (INIS-mf—10715) **Radioactive waste disposal in the Gorleben salt deposit. Opinions of geoscientists for the public hearing in the Committee for the Interior of the German Bundestag on June 20, 1984. (Excerpts from protocol No. 31).** Gizycki, P. von (ed.). (Institut fuer Angewandte Oekologie e.V., Freiburg im Breisgau (Germany, F.R.)). Apr 1985. 186p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87753296/JAW.

Werkstattreihe.; No. 16.

In the opinion of five experts, the protective function of the overlying rock as a barrier has turned out to be questionable after borings and measurements carried through at Gorleben. Moreover, the results have also raised doubts about the geological safety of the salt deposit as a barrier in the long run. The geological multi-barrier concept must be discarded. Not only critics, but also 3 advocates from the field of official research on radioactive waste disposal state their opinion.

331 (INIS-mf—10718) **Static corrosion of radioactive glass at 40/sup 0/C and corrosion of radioactive glass under dynamic conditions. Final report JSS project phase III.** (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Sep 1986. 63p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753219/JAW.

JSS project - technical report.; No. 86-01.

The goals of the project were to establish to what extent results obtained on non-radioactive glass are applicable to real waste glasses and also to develop a basis for understanding the effects of the components in the waste package on the glass dissolution behaviour as well as to obtain basic data on the temperature dependence of dissolution and the glass behaviour under flow conditions. Based on the results from these initial three phases, a model for predicting the dissolution behaviour of highly radioactive glass under realistic conditions in a granitic repository is being developed and refined.

332 (INIS-mf—10884) **Processing of radioactive wastes from nuclear power facilities with LWR reactors. Pt. 2.** Neumann, L. (ed.). (Ceskoslovenska Komise pro Atomovou Energii, Prague). 1985. vp. (CONF-8511274—Vol.2). NTIS (US Sales Only), PC A20/MF A01. Order Number DE87780125/JAW.

From Conference on processing of radioactive wastes from nuclear power facilities with LWR reactors; Luhacovice, Czechoslovakia (18 Nov 1985).

Separate abstracts have been prepared for paper from this conference on the processing of radioactive wastes from LWR reactors. The conference was held in Czechoslovakia, November 18-21, 1985.

333 (IPEN-Pub—112) **Contribution of IPEN-CNEN/ SP to the Seminar on Management Options for Low and Intermediate Level Wastes in Latin America.** (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). Jul 1987. vp. (CONF-861065—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780012/JAW.

From Seminar on management options for low and intermediate level wastes in Latin America; Rio de Janeiro, Brazil (13 Oct 1986).

Individual papers were processed separately for the data bases.

334 (KFK—4265) **Corrosion behaviour of container materials for the disposal of high-level waste forms in rock salt formations.** Smailos, E.; Schwarzkopf, W.; Koester, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). May 1987. 71p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753320/JAW.

Extensive laboratory-scale experiments to evaluate the long-term corrosion behaviour of selected materials in brines and first in situ experiments were performed. In the laboratory experiments the materials Ti 99.8-Pd, Hastelloy C4 and hot-rolled low carbon steel as well cast steel, spheroidal cast iron, Si-cast iron and the Ni-Resists type D2 and D4 were investigated. The investigated parameters were: temperature, gamma-radiation and different compositions of salt brines.

335 (LA-UR—87-2901) **The use of a heterogeneity-based isotherm to interpret the transport of reactive radionuclides in volcanic tuff media.** Polzer, W.L.; Fuentes, H.R. (Los Alamos National Lab., NM (USA); Texas Univ., El Paso (USA)). 1987. Contract W-7405-ENG-36. 19p. (CONF-870965—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000517/JAW.

From International conference on chemistry and migration behavior of actinides and fission products in the geosphere; Munich, F.R. Germany (14 Sep 1987).

The sorption of cesium and strontium has been modeled with a heterogeneity-based isotherm equation for various tuff materials including those within a sequence of geologic stratigraphic units. The theory of the isotherm foresees the relative retardation and the chemical dispersion of the studied radionuclides during transport. The concepts of heterogeneity of sites and variability in the maximum number of sites available for sorption are incorporated into the model. 16 refs., 4 figs., 3 tabs.

336 (LBL—21807) **Mass transfer of soluble species into backfill and rock.** Chambre, P.L.; Kang, C.H.; Lee, W.W.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Jul 1986. Contract AC03-76SF00098. 9p. (UCB-NE—4085; CONF-861102—49). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000471/JAW.

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

This report describes a mathematical model that estimates the rate that cesium and iodine isotopes would migrate from spent fuel rods after emplacement in a geologic repository that is subsequently flooded with ground water. 4 refs., 2 figs. (TEM)

337 **(LBL—22361) Development of the non-equilibrium reactive chemical transport code CHMTRNS.** Noorishad, J.; Carnahan, C.L.; Benson, L.V. (Lawrence Berkeley Lab., CA (USA); Geological Survey, Denver, CO (USA)). Sep 1987. Contract AC03-76SF00098. 230p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88000682/JAW.

A temperature-dependent nonequilibrium reactive chemical transport code has been developed on the basis of earlier work at Lawrence Berkeley Laboratory. The code is capable of simulating kinetic calcite and silica dissolution, irreversible glass dissolution, oxidation and reduction, and stable carbon isotope fractionation during transport. In the main part of the report necessary fundamentals and related algorithms are presented. Appendices 1 to 10 provide samples of inputs and outputs of solved problems. Appendices 11 and 12 include, respectively, the input preparation guide and the Fortran IV listing of the developed code CHMTRNS.

338 **(LBL—23636) Pressure-induced brine migration into an open borehole in a salt repository.** Hwang, Y.; Chambre, P.L.; Lee, W.W.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 6p. (CONF-871101—62; UCB-NE—4100). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014076/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

This report provides some solutions to models that predict the brine accumulation in an open borehole. In this model, brine flow rates are controlled by pressure differences between the salt and the borehole. (TEM)

339 **(LBL—23637) Pressure-induced brine migration in consolidated salt in a repository.** Hwang, Y.; Chambre, P.L.; Lee, W.W.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 7p. (CONF-871101—61; UCB-NE—4101). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014077/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

This report describes a mathematical model for brine migration through intact salt near a radioactive waste package emplaced in salt. Solutions indicate limited movement following ten years emplacement. (TEM)

340 **(LBL—23639) Time-dependent nuclide transport through backfill into a fracture.** Kang, C.H.; Chambre, P.L.; Lee, W.W.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 7p. (CONF-871101—53; UCB-NE—4103). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014116/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

This paper presents a transient analysis of radionuclide transport through backfill into a fissure. This report considers a waste canister surrounded by backfill in a borehole intersected by a fracture, in water-saturated rock. Radionuclides are released at a constant concentration C/sub s/ at the waste surface into the backfill. Ground water flows in the fissure. We assume no ground-water flow in the backfill, so that radionuclide transport through the backfill is controlled by molecular diffusion. 3 refs., 2 figs.

341 **(NAGRA-NTB—81-04) Potential site areas for a final repository Type B. Volume 2: Candidate site areas.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1981. 191p. (In German). Nagra, CH-5401 Baden, Switzerland.

The investigation program for the final disposal of low- and intermediate-level radioactive wastes is showing significant progress. Engineering-technical project studies have shown possible methods for the construction and operation of a repository and defined the technical conditions dependent on a variety of different host rocks. Parallely to these engineering studies, geological maps and profiles, historical explorations and literature studies were evaluated in order to set up an inventory of the relevant host rocks for the construction of a repository for low- and intermediate-level radioactive wastes in Switzerland. The results of these geological analyses are presented in this report. Based on geological and technical considerations, about one hundred potential site areas for a repository for low- and intermediate-level radioactive wastes came into question. From the geological point of view a number of site areas merited detailed geological investigations. In an evaluation process twenty potential site areas have been chosen and described in more detail. They are foreseen for further investigation.

342 **(NAGRA-NTB—81-04) Final disposal of low- and intermediate-level radioactive wastes in Switzerland. Potential site areas for a final repository Type B. Volume 1: Basics and site selection procedure.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1981. 96p. (In German). Nagra, CH-5401 Baden, Switzerland.

The investigation program for the final disposal of low- and intermediate-level radioactive wastes is showing significant progress. Engineering-technical project studies have shown possible methods for the construction and operation of a repository and defined the technical conditions dependent on a variety of different host rocks. Parallely to these engineering studies, geological maps and profiles, historical explorations and literature studies were evaluated in order to set up an inventory of the relevant host rocks for the construction of a repository for low- and intermediate-level radioactive wastes in Switzerland. The results of these geological analyses are presented in this report. Based on geological and technical considerations, about one hundred potential site areas for a repository for low- and intermediate-level radioactive wastes came into question. From the geological point of view a number of site areas merited detailed geological investigations. In an evaluation process twenty potential site areas have been chosen and described in more detail. They are foreseen for further investigation.

343 **(NAGRA-NTB—81-08) Comparative overview of dangers, protective measures and risks for the final disposal of radioactive wastes.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1981. 98p. (In German). Nagra, CH-5401 Baden, Switzerland.

The purpose of this report is to present an overview of the anticipated risks of geological disposal of radioactive wastes and to compare these to 'conventional' risks, which voluntarily or involuntarily are associated with human activities and have accompanied mankind for long times. Radioactive wastes which result from the generation of electricity by commercial nuclear reactors as well as those originating from research, industrial and medical applications necessitate prolonged isolation from the biosphere to their long-lived, although decaying, toxicity. Chapter 2 of this report contains a survey of the nature and extent of the potential hazard of radioactive waste, drawing attention to the fact that the toxicity of radionuclides is comparable to that of nonradioactive chemical compounds. The possibility of adverse effects on the public cannot be ruled out for either kind of waste. Current plans aim at the safe and effective disposal of radioactive wastes in deep and stable geological formations which should serve as hosts for engineered final repositories. For a final repository to be suitable, the site chosen should be free from circulating groundwater or the free movement of the groundwater must be strongly restricted. In order to prevent radioactive substances migrating away from the final repository in which they have been placed, it is planned to utilise natural and man-made barriers which function largely independently from each other. Thorough knowledge of the properties of man-made barriers, is as important as knowledge of the natural barriers, which are determined by the geology and hydrogeology of the site of the final repository. This principle of protection is known as a 'multiple-barrier concept' and is considered capable of providing safe disposal of radioactive wastes.

344 **(NAGRA-NTB—81-09) Stripa Project. Annual report 1980.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Apr 1981. 32p. Nagra, CH-5401 Baden, Switzerland.

This annual report is prepared by the Project Manager in accordance with Article 2, Paragraph 8 of the draft Stripa Project Agreement with the aim to inform the OECD Nuclear Energy Agency Committee on Radioactive Waste Management and its Coordinating Group on Radioactive Waste Disposal into Geologic Formations as well as the Participants in the Project about the general progress of work during 1980.

345 **(NAGRA-NTB—81-15) Swiss surveillance programme for the deep sea disposal site for radioactive wastes in the North East Atlantic.** Nyffeler, F.; A'der, J.C. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1981. 43p. (In French). Nagra, CH-5401 Baden, Switzerland.

This report describes the project initiated by NAGRA in order to allow Swiss participation in the surveillance program at the North East Atlantic dumpsite, used for disposal of low and medium radioactive wastes. The basic concepts of this surveillance program, and also the related scientific research in progress in various countries involved in the Multilateral Consultation and Surveillance Mechanism of the OECD, are briefly reviewed. The NAGRA program is concerned with the study of processes allowing the transfer of radionuclides at the water-sediment interface. This research topic was selected in view of the scientific capabilities available within Switzerland. An active participation in oceanographic cruises at the dumpsite is foreseen from 1982, and the work which will be carried out is described. This proposed contribution to the program coordinated by the NEA allows Switzerland to fulfil its obligations within the framework of the London Convention and Multilateral Consultation and Surveillance Mechanism of the OECD.

346 **(NAGRA-NTB—82-01) Solidification of radioactive borated waste concentrates from pressurized water reactors.** Laske, D. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Mar 1982. 88p. (In German). Nagra, CH-5401 Baden, Switzerland.

New mixtures for solidification of borated waste concentrates have been developed under a Nagra contract by EIR in conjunction with staff of Beznau power station where the wastes are produced. The objective of the project was to find a solidification recipe which best enabled the wastes to fulfill the necessary conditions for geologic disposal with respect to their mechanical strength, water resistance, sulphate resistance, long-term stability and leachability. Boric acid or borates in concentrates require additional calcium hydroxide in cements used for solidification so that precipitation of calcium metaborate which is necessary for hardening will take place. An initial scoping study was performed on inactive concentrates before the range of cements and additives was further reduced in a second series of experiments. With active concentrates, 11 recipes were tested, including measurement of leach rates. Addition of Trass in the ratio to cement of 30:100 reduced caesium leach rates by around 2 orders of magnitude. The chosen mixture A.11. was then tested on a technological scale. In 200 l drums at the Beznau facility mixing and stirring techniques leading to hardening in acceptable times were established. The hardening process and the temperatures were monitored. The strength, water resistance and sulphate resistance were measured for the mix from the drum. Since the beginning of 1982 the method has been in use for borated concentrates at Beznau with the approval of the safety authorities. The method is being patented; further details are available from the author.

347 **(NAGRA-NTB—82-02) Monitoring of radioactive wastes.** Houriet, J.P. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Aug 1982. 214p. (In French). Nagra, CH-5401 Baden, Switzerland.

The estimation of risks presented by final disposal of radioactive wastes depends, among other things, on what is known of their radioisotope content. The first aim of this report is to present the current state of possibilities for measuring (monitoring) radionuclides in wastes. The definition of a global monitoring system in the framework of radioactive waste disposal has to be realized, based on the information presented here, in accordance with the results of work to come and on the inventory of wastes to be stored. Designed for direct measurement of unpackaged wastes and for control of wastes ready to be stored, the system would ultimately make it possible to obtain all adaquate information about their radioisotope content with regard to the required disposal safety. The second aim of this report is to outline the definition of such a global system of monitoring. Designed as a workbase and reference source for future work by the National Cooperative for the Storage of Radioactive Waste on the topic of radioactive waste monitoring, this report describes the current situation in this field. It also makes it possible to draw some preliminary conclusions and to make several recommendations. Centered on the possibilities of current and developing techniques, it makes evident that a global monitoring system should be developed. However, it shows that the monitoring of packaged wastes will be difficult, and should be avoided as far as possible, except for control measurements.

348 **(NAGRA-NTB—82-03) Long-term stability of cement and concrete for nuclear waste disposal under normal geologic conditions.** Shin, W.S. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Mar 1982. 118p. Nagra, CH-5401 Baden, Switzerland.

The nuclear power industry which has developed in this century has raised new and interesting issues in the management and disposal of radioactive waste materials. The treatment and disposal of radioactive waste involve both environmental considerations and technical processing problems. The increasing emphasis upon environmental considerations as they relate to nuclear wastes has focused additional attention upon the long-term stability of cement and concrete for nuclear waste disposal under potential geologic repository conditions. Brief descriptions of scientific background to cement and concrete, and discussions related to the stability of structure, corrosion of reinforcement, possible environmental conditions in a potential repository site in Switzerland, and the influence of environment on cement and concrete are presented. More emphasis is placed on the thermal and pressure environment, and the effect of groundwater in a reducing environment. The cement compositions for the immobilization of radioactive wastes are briefly commented upon from the standpoint of the cementing mechanism for compatibility with radioactive wastes, leachability, and chemical and mechanical durability. Long-term stability of concrete based on chemical change, structural behaviour and mechanical integrity is considered during the period of 0-100 years and the period of 10/sup 2/-10/sup 4/ years. Included are suggestions for future work, which would provide vital information for predicting more accurately the long-time behaviour of cement and concrete used in the repository environment.

349 **(NAGRA-NTB—82-11) Establishing storage criteria for a Swiss low-level waste repository.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1982. 55p. Nagra, CH-5401 Baden, Switzerland.

A methodology based upon safety criteria has been developed for the allocation of future Swiss radioactive waste arisings to one of the three repository types envisaged for the national waste disposal concept. The methodology has been applied to low-level wastes from decommissioning activities, intended primarily for storage in the so-called Type A repository. For this initial application 4 scenarios were considered. Three of these are related to the catastrophic failure of the repository and one to anticipated normal water intrusion. Maximum average concentrations for 59 radionuclides of interest have been derived for the four scenarios and resulting maximum permissible concentrations for radionuclides, in the waste capable of being stored in a Type A repository have been obtained. The results show 39 radionuclides to be relevant for further investigations and an appropriately grouped specific activity inventory of these 38 radionuclides in decommissioning wastes was established. Using this inventory a first attempt was made to partition the wastes and determine the potential storage capabilities for a Type A repository. In the work a simple repository model which does not take full account of combined effects of the engineered safety barriers was used. A storage capability of much less than half of the originally envisaged capacity has been arrived at. This result can be accounted for by the differences between present modelling

assumptions and parameters and those used previously, by the fact that the partitioning of the wastes was not detailed, and by the conservative assumptions made concerning concentrations of radionuclides in the waste. It is clear that more detailed information on waste arisings and on the behaviour of the technical safety barriers in the repository system can lead to increases in the storage capacity predicted for a Type A repository.

350 **(NAGRA-NTB—83-18) Literature study on the breakdown of bitumen by microorganisms.** Bachofen, R.; Dubach, A.C.; Tesch, A.W.; Luescher, D. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 38p. (In German). Nagra, CH-5401 Baden, Switzerland.

Bitumen is used for conditioning of low and intermediate level radioactive wastes. The matrix material used has to guarantee, together with other safety barriers, that the radioactive material is safely retained in the repository over a prolonged period of time and is not released to the environment. It is known that bitumen is relatively resistent to the processes of decomposition. However, in the presence of certain environmental conditions decay or decomposition of bitumen can take place. Organisms that are responsible for such activities can be found more or less everywhere. The work published so far contains only few data on decomposition rate and gas formation in bitumen. For a better understanding of these processes for environmental conditions and storage periods that are relevant for waste disposal sites, additional investigations seem to be necessary.

351 **(NAGRA-NTB—83-19) Solidification of active Powdex ion-exchange resins from boiling water reactors.** Laske, D.; Huebner, W.; Kuenzle, M. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1983. 94p. (In German). Nagra, CH-5401 Baden, Switzerland.

An optimum recipe for the cement solidification of spent Ion-Exchange-Resins (type Powdex) from the BWR power plant Muehleberg, Switzerland, was developed at the EIR under a NAGRA contract. The recipe had to be optimized with regard to the amount of Powdex-resins in the matrix volume. The product should satisfy the necessary conditions for a final disposal in geologic formations of Switzerland. Important criteria are compressive strength, water resistance, sulphate and mineralwater resistance and low leachability of the contained radionuclides. Three extensive series of inactive pretests and two series of recipes using active waste from a power plant showed the recipe B. 54/55 to be the best. It allows the solidification of 41 kg Powdex-Mixture (weight of dry resins) in a matrix volume of 200 liters. Technical tests were carried out on a 1:1 scale, using two different mixing processes. With both processes the solidified products were of the same high quality as those obtained on a laboratory scale. Corresponding proposals were submitted, but it has not yet been decided which technical process will finally be chosen at the Muehleberg power station. For the EIR recipe a patent has been applied for.

352 **(NAGRA-NTB—83-20) Preliminary calculations of the temperature distributions around a Type C (highly active) nuclear waste repository.** Hopkirk, R.J.; Gilby, D.J.; Schwanner, I. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1983. 68p. Nagra, CH-5401 Baden, Switzerland.

Calculations are presented of temperature distributions expected in and around a repository for high level nuclear waste in a crystalline bedrock site, according to the NAGRA Type C concept. For this purpose, a preliminary set of repository design parameters has been selected. Initial, undisturbed rock temperature was set at 55 degrees C. Peak temperature rises in the waste packages of 100 - 120 degrees C, in the backfill material of 40 - 60 degrees C and in the host rock of less than 30 degrees C are obtainable. This means that no insoluble problems are to be expected from the thermal side and that an acceptable thermal environment can be achieved by suitable selection of the design parameters. On the other hand, it is also clear that neither in the near field nor in the far field can the effects of temperature perturbations be neglected in the processes of design and safety analysis. Calculations similar to those presented in this report will be repeated in the natural course of the design process with the aim of guaranteeing even lower thermal loadings on materials and environment.

353 **(NAGRA-NTB—84-47) Inventory and characterization of the radioactive wastes in Switzerland.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 678p. (In German). Nagra, CH-5401 Baden, Switzerland.

This report represents a data base of Swiss radioactive waste inventory and characteristics. A short introduction describes the overall waste package characteristics (such as dimensions, heat output, dose rate), materials, and radionuclide activities of the waste package to be disposed of. Following are data for 93 representative waste groups from reprocessing of spent fuel, operation and decommissioning of nuclear power plants and from medicine, industry and research. For a reference nuclear power program of 240 GW(e)yr the amount of the waste packages and their yearly arisings are derived. The data constitutes the waste inventory in the alternative of waste disposal with reprocessing of spent fuel, which was considered in the project 'Guarantee' 1985. In the second volume of this project report (Nagra Gewaehr Bericht NGB 85-02) further background to the data base and to the waste group definition is given.

354 (NAGRA-NTB—86-26, pp 4-8) **Make up of crystalline bedrock - crystalline body and blocks.** Huber, M.; Huber, A. (Dres. M. und A. Huber, Beratende Geologen, Switzerland). Sep 1986. (In German). Nagra, CH-5401 Baden, Switzerland.

In Some thoughts concerning the extent of crystalline host rock for a final repository for radioactive wastes in Northern Switzerland.

Statements of a geological nature can be made on the basis of investigations of the bedrock exposed in southern Black Forest and these can, in the form of prognoses, be applied to the crystalline Basement of northern Switzerland. Such statements relate to the average proportions of the main lithological groups at the bedrock surface and the surface area of the granite body. Some of the prognoses can be compared and checked with the results from the deep drilling programme in northern Switzerland. Further, analogical interferences from the situation in the southern Black Forest allow predictions to be made on the anticipated block structure of the crystalline Basement.

355 (NAGRA-NTB—86-26, pp 9-11) **How can hydraulic investigations in deep boreholes contribute to the understanding of water flow paths?.** Zuidema, P. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle, NAGRA, Baden, Switzerland). Sep 1986. (In German). Nagra, CH-5401 Baden, Switzerland.

In Some thoughts concerning the extent of crystalline host rock for a final repository for radioactive wastes in Northern Switzerland.

From the point of view of safety analysis, water flow paths play an extremely important role as transport paths for radionuclides which may be released from a waste repository. After a short introduction, this article investigates the sources of the information required for characterising water flow systems and, in particular, how the hydraulic investigations carried out in deep boreholes can be of assistance in this respect.

356 (NAGRA-NTB—86-26, pp 1-3) **Some thoughts concerning the extent of crystalline host rock for a final repository for radioactive wastes in Northern Switzerland.** McCombie, C.; Kowalski, E.; Thury, M. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle, NAGRA, Baden, Switzerland). Sep 1986. (In German). Nagra, CH-5401 Baden, Switzerland.

In Some thoughts concerning the extent of crystalline host rock for a final repository for radioactive wastes in Northern Switzerland.

Although no selection of a repository site was required for Project Gewaehr, specific geological field data had to be used for the geosphere model data-set. Nagra decided to base the model data-set on the conditions found at one side, rather than using a synthesised data-set. This article lists the most important questions

relating to demonstration of repository safety, explains how the relevant answers are obtained and closes with a discussion of the conclusions reached.

357 **(NAGRA-NTB—87-04) Working programme for borehole OBS-1.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Mar 1987. 63p. (In German). Nagra, CH-5401 Baden, Switzerland.

On September 30, 1985, the Federal Council allowed investigations in three areas for site suitability with regard to the disposal of low- and intermediate-level radioactive wastes to proceed. The present report gives a summary of the working program for the investigation phase I at the candidate site Oberbauenstock. In part 1 the surface geological work, source measurements and geophysical measurements in the underground construction of the Seelisberg tunnel are explained and some special aspects such as construction-technical feasibility and safety measures are handled. In part two the scientific investigation program for the two planned short boreholes each of ca 100 m depth and the exploratory borehole of ca 420 m depth are introduced. Besides geological, hydrogeological, geophysical and rock-mechanical investigations in the field, geological/mineralogical analyses on bore cores as well as physical/chemical analyses on water and gas samples are covered.

358 **(NPC(W)-R—853) Review of DOE chemical and geochemical research programmes (for disposal of low and intermediate level waste).** May, R. (National Nuclear Corp. Ltd., Whetstone (UK); Department of the Environment, London (UK)). Jan 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752940/JAW.

A study of 26 DOE sponsored research programmes has been carried out with respect to their coverage of various chemical and geochemical issues posed by the proposed disposal of low and intermediate level wastes in a land repository. The study also took into account various experimental programmes sponsored by NIREX and abroad. The findings of the study are reported here.

359 **(NUREG/CR—4956) System performance of high-level waste package components.** Nicolosi, S.L.; Kurth, R.E.; Quayle, S.F.; Hess, D.J.; Markworth, A.J. (Battelle Columbus Div., OH (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Sep 1987. 276p. NTIS, PC A13/MF A01 - GPO. Order Number DE88900002/JAW.

This report presents analytical and experimental studies that describe the performance of nuclear waste packages at the system level. Several water chemistry modules were developed, and ground-water-radiolysis studies were performed to examine the production of radiolytic species at the outside surface of waste packages. Uncertainty analysis studies with a UO_2 water chemistry model assessed the importance of input parameters on the variability of calculated solubilities. A shell for a computer code was developed that provides an alternative method for examining the system performance of high-level waste packages. Integral experiments were conducted to examine interactions between components of the waste package and repository, bringing together elements of repository environments with components of spent-fuel waste forms. The system performance investigations showed that radiolysis effects are not significant when the gamma source is shielded by the overpack. The production of oxalate is related to bicarbonate concentration and dose rate. The dissolution of UO_2 may be influenced significantly by solution pe and chloride concentration. Spent fuel performance studies showed that spent fuel rod sections with microscopic failure openings showed unexpected high release rates for some radionuclides when compared with releases from macroscopic failure openings. 121 refs., 81 figs., 30 tabs.

360 **(ORNL/TM—10025) Cost estimate of grouting the proposed test pits at Idaho National Engineering Laboratory using the ORNL-recommended grouts.** Spence, R.D. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000028/JAW.

EG & G Idaho will construct three experimental pits to simulate the TRU waste trenches at Idaho National Engineering Laboratory (INEL). Two of these pits will be grouted and then one will be destructively examined as soon as the grout cures and the other will be monitored for 10 years. Oak Ridge National Laboratory (ORNL) is evaluating grouts and will recommend a grout to EG & G Idaho to reduce the permeability of the pit, fill the large voids, and encapsulate the waste. A previous ORNL report (ORNL/TM-9881) discusses the grouts evaluated and the grout recommended based on those evaluations. This report evaluates the economics of grouting the experimental pits. The cost of double grouting two of the EG & G Idaho design pits at the Idaho National Engineering Laboratory using lance injection was estimated to be $100,000. Jet grouting the same two pits was estimated to cost $85,000. Both should be tried as part of the test EG & G Idaho is conducting.

361 **(PNL—6302) Evaluation of the transport and resuspension of a simulated nuclear waste slurry: Nuclear Waste Treatment Program.** Carleson, T.E.; Drown, D.C.; Hart, R.E.; Peterson, M.E. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 134p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88000247/JAW.

The Department of Chemical Engineering at the University of Idaho conducted research on the transport and resuspension of a simulated high-level nuclear waste slurry. In the United States, the reference process for treating both defense and civilian HLLW is vitrification using the liquid-fed ceramic melter process. The non-Newtonian behavior of the slurry complicates the evaluation of the transport and resuspension characteristics of the slurry. The resuspension of a simulated (nonradioactive) melter feed slurry was evaluated using a slurry designated as WV-205. The simulated slurry was developed for the West Valley Demonstration Project and was used during a pilot-scale ceramic melter (PSCM) experiment conducted at PNL in July 1985 (PSCM-21). This study involved determining the transport characteristics of a fully suspended slurry and the resuspension characteristics of settled solids in a pilot-scale pipe loop. The goal was to predict the transport and resuspension of a full-scale system based on rheological data for a specific slurry. The rheological behavior of the slurry was evaluated using a concentric cylinder rotational viscometer, a capillary tube viscometer, and the pilot-scale pipe loop. The results obtained from the three approaches were compared. 40 refs., 74 figs., 15 tabs.

362 **(PNL-SA—14059) Standardized test methods for use in waste compliance testing in the Department of Energy's Waste Acceptance Process.** Mellinger, G.B. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 9p. (CONF-861207—114). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000094/JAW.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

This paper proposes a set of tests for use in demonstrating compliance with the existing WAPS (both of which deal with glass waste forms). Some of these tests have been standardized. Others are undergoing standardization or are under development, and may ultimately require standardization. The final decision about which tests will be appropriate for waste compliance testing will be made by the repository projects and the DOE Office of Civilian Radioactive Waste Management. Input from the waste form producers and the NRC will be considered during this decision making process. 8 refs., 1 fig., 1 tab.

363 **(PNL-SA—14237) Engineered sorbent barriers for low-level waste disposal.** Mitchell, S.J.; Freeman, H.D.; Buelt, J.L. (Pacific Northwest Lab., Richland, WA (USA)). 1986. Contract AC06-76RL01830. 15p. (CONF-860990—16). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000084/JAW.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Pacific Northwest Laboratory is developing sorbent materials to prevent the migration of radionuclides from low-level waste sites. These materials would allow water to pass, preventing the bathtub effect at humid sites. Screening studies identified promising

sorbent materials for three key radionuclides: for cesium, greensand; for cobalt, activated charcoal; and for strontium, synthetic zeolite or clinoptilolite. Mixtures of these sorbent materials were tested in 0.6-m-diameter columns using radioactive leachates. To simulate expected worst-case conditions, the leachate solution contained the radionuclides, competing cations, and a chelating agent, adjusted to a pH of 5. A sorbent barrier comprised of greensand (1 wt %), activated charcoal (6 wt %), synthetic zeolite (20 wt %), and soil (73 wt %) achieved the decontamination factors necessary to meet the regulatory performance requirements established for this study. Sorbent barriers can be applied to shallow land burial, as backfill around the waste or engineered structures, or as backup to other liner systems. 2 refs., 6 figs., 3 tabs.

364 **(PNL-SA—14502) Application of GEOTHER/VT4 to assess groundwater transients in a high level radioactive waste repository.** Bian, S.H.; Budden, M.J.; Yung, S.C. (Pacific Northwest Lab., Richland, WA (USA); Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). May 1987. Contract AC06-76RL01830. 18p. (CONF-8710141—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000086/JAW.

From International conference on groundwater contamination; Amsterdam, Netherlands (26 Oct 1987).

The GEOTHER/VT4 code is a modified and improved version of the GEOTHER code. It was applied to a two-dimensional simulation of a single waste package container in a high-level waste repository to predict the thermal-hydraulic environment where steam formation may occur. The groundwater and thermal conditions are important for waste package container corrosion, packing material swelling tests, and for evaluation of the near-field geochemical conditions. The waste package was assumed to be situated in the Cohassett flow of the Hanford Washington Site bounded by the flow top and flow bottom. The calculation indicates that the maximum steam formation occurs at about 10 years after waste package emplacement. The two-phase (steam and water) zone extends about 0.5 m above and below the waste package surface. After this period, the saturation profile stays essentially unchanged until 50 years after container emplacement. Then the two-phase zone condenses until resaturation at about 62 years after container emplacement.

365 **(PNL-SA—14998) Radiation effects in nuclear waste glasses.** Weber, W.J. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 33p. (CONF-870783—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000089/JAW.

From Radiation effects in insulators-4 conference; Lyon, France (6 Jul 1987).

The effects of radiation from alpha and beta decay on the performance and properties of borosilicate nuclear waste glasses are reviewed and discussed. Alpha decay results in volume changes of up to +-1.2%. Stored energy, released over a wide temperature range, does not generally exceed 150 J/g. Changes in leach rates are not as well defined, but increases of at least a factor of 3 can be expected. Ionization from alpha, beta, and gamma radiation results in volume changes, radiolytic decomposition, significant bubble formation, decreases in hardness, and increases in fracture toughness. 39 refs., 9 figs., 3 tabs.

366 **(RFP—4100) Actinide removal from aqueous solution with activated magnetite.** Kochen, R.L.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 10 Aug 1987. Contract AC04-76DP03533. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000710/JAW.

An actinide aqueous waste treatment process using activated magnetite has been developed at Rocky Flats. The use and effectiveness of various magnetites in lowering actinide concentrations in aqueous solution are described. Experiments indicate that magnetite particle size and pretreatment (activation of the magnetite surface with hydroxyl ions greatly influence the effective use of magnetite as an actinide adsorbent. With respect to actinide removal, $Ba(OH)_2$-activated magnetite was more effective over a broader pH range than was NaOH-activated magnetite. About 50% less $Ba(OH)_2$-activated magnetite was required to lower plutonium concentration from 10^{-4} to 10^{-8} g/l. 7 refs., 8 tabs.

367 **(RFP—4135) Rapid screening method for plutonium in mixed waste samples.** Somers, W.; Culp, T.; Miller, R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 9p. (CONF-870705—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013383/JAW.

From Annual meeting of the Health Physics Society; Salt Lake City, UT, USA (5 Jul 1987).

A waste stream sampling program was undertaken to determine those waste streams which contained hazardous constituents, and would therefore be regulated as a hazardous waste under the Resource Conservation and Recovery Act. The waste streams also had the potential of containing radioactive material, either plutonium, americium, or depleted uranium. Because of the potential for contamination with radioactive material, a method of rapidly screening the liquid samples for radioactive material was required. A counting technique was devised to count a small aliquot of a sample, determine plutonium concentration, and allow the sample to be shipped the same day they were collected. This technique utilized the low energy photons (x-rays) that accompany α decay. This direct, non-destructive x-ray analysis was applied to quantitatively determine Pu-239 concentrations in industrial samples. Samples contained a Pu-239, Am-241 mixture; the ratio and/or concentrations of these two radionuclides was not constant. A computer program was designed and implemented to calculate Pu-239 activity and concentration (g/ml) using the 59.5 keV Am-241 peak to determine Am-241's contribution to the 17 keV region. Am's contribution was subtracted, yielding net counts in the 17 keV region due to Pu. 2 figs., 1 tab.

368 **(RHO-RE-SR—87-24-P) Results of the Separations Area ground-water monitoring networks for 1986.** Law, A.G.; Serkowski, J.A.; Schatz, A.L. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jul 1987. Contract AC06-77RL01030. 204p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE87012992/JAW.

The Separations Area ground-water monitoring network consisted of 137 wells. Samples from wells in the monitoring network were collected on a monthly, quarterly, or semiannual schedule, depending on the history of the liquid waste disposal site. Samples were analyzed selectively for total alpha, total beta, tritium, ^{90}Sr, ^{137}Cs, ^{60}Co, ^{106}Ru, total uranium and nitrate. Average concentrations of contaminants in most wells were essentially the same in 1986 as in 1985. The DCG for tritium was exceeded at two PUREX cribs. The ACL specified for ^{90}Sr was exceeded in three wells near the 216-A-25 Pond. Disposal of effluents to the pond decreased as the main pond was reduced in width to a ditch leading the overflow pond. The ACL guidelines for uranium were exceeded although concentrations were below the DCG; the source of this uranium is probably the inactive 216-B-12 crib. Uranium concentrations above the ACL but below the DCG were also observed at the 216-U-14 ditch and the source is under evaluation. The inactive 216-B-5 reverse well exceeded the DCG for ^{90}Sr and the ACL for ^{137}Cs and uranium. Inactive facilities exceeding Rockwell guidelines were the 216-S-1/2 cribs, 216-U-1/2 cribs, the 216-U-10 pond, and the 216-U-6 crib. The 216-S-1/2 cribs have historically had high ^{137}Cs concentrations because of localized contamination but are below the DCG. Uranium concentrations, which are above the DCG, have stabilized at the 216-U-1/2 cribs after the remedial pumping and uranium removal conducted in 1985. Possible additional action is currently being evaluated. Disposal of the effluent from the ion exchange column to the 216-S-25 crib resulted in ground-water concentrations that exceeded Rockwell guidelines but below the DCG. Ground water near the 216-U-10 pond remains elevated but below the DCG due to past disposal to the pond, which was deactivated in 1984. 23 refs., 25 figs., 26 tabs.

369 **(SAND—84-7100) Nevada Nuclear Waste Storage Investigations Project: Final report of core drill conceptual design study for retrieval of radioactive waste disposed in a geologic repository.** (Robbins Co., Kent, WA (USA); Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014272/JAW.

The system consists of an out-of-hole drive system with a rotating drill string attached to a core barrel type drill head. This report describes the system's capacity, equipment specifications, operation procedures, manpower and equipment requirements, and capital and operating costs. Although the system is deemed feasible, it is costly, complicated, and labor intensive for general use in retrieval operations. Similar systems may, however, be candidates for use in special situations in which retrieval operations are to be completed under abnormal conditions. 16 figs., 5 tabs.

370 **(SAND—86-1495) The geologic structures observed in drillhole DOE-2 and their possible origins: Waste Isolation Pilot Plant.** Borns, D.J. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000267/JAW.

Questions remain as the origins of evaporite deformation within the Salado and Castile formations. Two miles north of the WIPP site, a stacked sequence of depressions was indicated by shallow boreholes. Such structures raise questions regarding the role of dissolution and gravity tectonics at the WIPP site. To investigate these structures, DOE drilled hole DOE-2 north of the WIPP site. At DOE-2, the downward displacement of stratigraphic markers in the Salado confirmed the presence of stacked depressions, which were the primary target of the drilling program. The halitic units between the marker beds were thickened compared to the average section determined from basin-wide drilling. The remaining question is whether dissolution occurred in the underlying Castile and resulted in the deformation of the Salado. Markers in the anhydrite units indicate recumbent structures and thickening of the anhydrite units by folding. As a consequence, the Castile Formation is nearly its average thickness, with the folded thickness of anhydrite compensating for the missing halite. The nearby thickening of halite within the Castile, the absence of relic anhydrite laminae in the attenuated halite units, and the high strain fabric of the remaining halite suggest that dissolution was not the dominant process in the Castile. The favored hypothesis for the Castile structures is salt flow in response to gravity inversion of the anhydrite and halite units of the Castile. 21 refs., 18 figs.

371 **(SAND—86-2492) Microstructure of red clay from the central Pacific deep-sea basin: Significance to subseabed nuclear waste disposal.** Burkett, P.J.; Bennett, R.H.; Li, H.; Nastav, F.L.; Bryant, W.R.; Shephard, L.E.; Chiou, Wen-An. (Naval Ocean Research and Development Activity, NSTL, MS (USA); Texas A and M Univ., College Station (USA); Sandia National Labs., Albuquerque, NM (USA); Northwestern Univ., Evanston, IL (USA)). Jul 1987. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87015000/JAW.

The microstructure of deep-sea illitic red clay from the central Pacific Basin was investigated using transmission and scanning electron microscopy techniques. Gravity core samples ("undisturbed") and sediments from dredge hauls ("disturbed") were used in the investigations and analysis. Dredged samples were remolded and reconsolidated to equivalent in situ porosities by geotechnical engineers. To a first approximation, no significant difference in the fabric was observed between the undisturbed and remolded illitic sediment. Samples adjacent to the heater probe were subjected to temperatures slightly below 300°C. Slight preferential clay particle alignment probably resulting from shearing stresses developed in the sediment during probe insertion. Heating of the sediment did not appear to have a significant effect on the fabric, with the exception of localized "quasi-expansion" and flow features observed in the microfabric in the near field. 34 refs., 28 figs.

372 **(SAND—86-7013) Technical basis and parametric study of ground motion and surface rupture hazard evaluations at Yucca Mountain, Nevada.** (URS/John A. Blume and Associates, Engineers, San Francisco, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88000265/JAW.

The hazards of ground motion and primary fault rupture at Yucca Mountain, Nevada, were evaluated for earthquake occurrence models consisting of faults and background seismicity. This investigation estimated seismic hazard sensitivity to geologic parameters. Few Quaternary slip-rate data are available for faults in the site vicinity. Late Neogene apparent vertical slip-rates exhibit a correlation with mapped fault length, and this suggested the use of slip-rate/fault-length correlations as a device for assigning seismicity to faults. Correlations with power-law exponents of 1, 2, and 3 were used to construct models with varying relative activities of short and long faults. Seismicity models were constructed with alternate rupture-magnitude relations and varying b-values. Background seismicity was evaluated by subtracting fault-related activity from the historic regional activity. The calculated ground motion hazard was dominated by the Paintbrush Canyon and related faults and by background seismicity and was most sensitive to the assumed slip-rate function. Varying other parameters, including the regional seismic quality factor (Q) in the attenuation function, had relatively little effect. Surface rupture hazard was modeled using a joint probability for surface rupture displacement, length, and rupture radius exceedances, together with the fault-related earthquake recurrence models. The surface rupture hazard calculated for the Paintbrush Canyon fault, and related primary faults in the site vicinity, was most sensitive to the assumed slip-rate function. Surface rupture hazard was relatively insensitive to the (downdip) fault width.

373 **(SAND—87-0112) Simple models of the saturated zone at Yucca Mountain.** Barr, G.E.; Miller, W.B. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE87013975/JAW.

Head contours in the saturated zone underlying Yucca Mountain, Nevada, and its environs are derived on the basis of alternative interpretations of the influence of geologic structure on the flow of fluids. Numerical experiments examine the sensitivity of flow and transport to uncertainties in existing data and the response to assumed catastrophic changes in hydraulic conductivity. The calculations delineate the data that a performance assessment analyst might want. Faults controlling the flow are not a dominating feature. 11 refs., 28 figs., 12 tabs.

374 **(SAND—87-7037) Thermal/structural modeling of Test Series A of the small scale seal performance tests.** Van Sambeek, L.L.; Stormont, J.C. (RE/SPEC, Inc., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000263/JAW.

To ensure effective long-term sealing of nuclear waste repositories, adequate predictive capabilities of seal system thermal/structural behavior is required. Such modeling must consider the properties of the seal material as well as the host rock. In this report, various modeling efforts are described and discussed. Some results are compared to an in situ test on concrete seals in host rock salt at the Waste Isolation Pilot Plant (WIPP) facility. Preliminary efforts included one-dimensional models and limited finite element models. An experiment design approach, in conjunction with two-dimensional thermomechanical finite element modeling, determined the relative importance of various concrete and host rock properties on the response of the seal system. The assumed chemical expansivity of the concrete has a considerable influence on the early-time (180 day) response of the concrete/rock system. Subsequent finite element modeling produced good comparison between measured and calculated concrete temperatures and strains; fair comparison for concrete stress is obtained. The report concludes by giving present thermal/structural modeling capabilities and limitations, and the direction future development efforts will take. 19 refs., 14 figs., 2 tabs.

375 **(SKB-TR—86-12) PLAN 86 - costs for management of the radioactive waste from nuclear power production.** (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Jun 1986. 74p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753216/JAW.

The Swedish nuclear power utilities are responsible for adopting such measures as are necessary in order to ensure the safe management and disposal of spent nuclear fuel and radioactive

waste from the Swedish nuclear power reactors. This report presents a calculation of the costs for implementing all of these measures. The cost calculations are based on a scenario for management and disposal of the radioactive waste products, which is described in the report.

376 **(SKB-TR—86-16) Site investigation - equipment for geological, geophysical, hydrogeological and hydrochemical characterization.** Almen, K.E.; Andersson, O.; Fridh, B.; Johansson, B.E.; Sehlstedt, M.; Gustafsson, E.; Hansson, K.; Olsson, O.; Nilsson, G.; Axelsen, K. (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Sveriges Geologiska Undersoekning, Uppsala; Sveriges Geologiska Undersoekning, Luleaa; Royal Inst. of Tech., Stockholm (Sweden)). Nov 1986. 148p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87753222/JAW.

The investigations are performed within a site investigation program. In total about 60,000 m of cored 56 mm boreholes have been drilled and investigated at eight study sites. A summarized description of the main investigation methods is included. Instruments for geophysical investigations contains equipment for ground measurements as well as for borehole logging. The Geophysical investigations including the borehole radar measurements, are indirect methods for the geological and hydrogeological characterization of the rock formation. Great effort has been laid on the development of hydrogeological instruments for hydraulic tests and groundwater head measurements. In order to obtain hydrochemical investigations with high quality, a complete system for sampling and analysis of ground water has been developed.

377 **(SKB-TR—86-17) Analysis of groundwater from deep boreholes in Klipperaas.** Laurent, S. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). 22 Sep 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753217/JAW.

Groundwater from three boreholes in granitic rock at an investigation site in Klipperaas has been sampled and analysed. Water-bearing levels in the boreholes down to the deepest at 777 m were selected. Sensitive parameters such as redox potential, pH, sulphide and oxygen content are measured electrochemically on the flowing water in a system isolated from the air. Water, filter and gas samples are sent to several laboratories for further analysis. The present report is a presentation of the results of the ground-water analyses. The reliability of the results is discussed but there is no evaluation in relation to geology and hydrogeology. This report presents the basic results from the groundwater analyses to be further evaluated by experts in different fields.

378 **(SKB-TR—86-19) Correlation between tectonic lineaments and permeability values of crystalline bedrock in the Gideaa area.** Ericsson, L.O.; Ronge, B. (Swedish Nuclear Fuel and Waste Management Co., Stockholm; VIAK AB, Vaellingby (Sweden)). Nov 1986. 86p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753218/JAW.

A tectonic model within the Gideaa site have been constructed based on a fracture mapping of the outcrops and by help of an interpretation of the topography and lineaments. The model has been refined by supplementary fracture measurements in the near Gissjoe hydropower tunnel. Former geophysical investigations, slingram and magnetic anomalies, verify the model.

379 **(SKI-TR—87-1) Development of uncertainty analyses for the transport of radionuclides from a repository for high-level radioactive waste. Stage one.** Sundstroem, B. (Swedish Nuclear Power Inspectorate, Stockholm). Oct 1986. 131p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87753221/JAW.

The escape of radionuclides from a repository for high level waste is described by the near field model LCHCAL and the geosphere models GEO1/SU and NUCDIF. These models are used to calculate the radionuclide outflow to the biosphere. The uncertainties in the input parameters to the near field and geosphere models are handled by the uncertainty analysis models PARVAR and SYVAC/SU. The uncertainty analysis models have been tested on two nuclides, /sup 14/C and /sup 135/Cs, for cases with pure surface sorption and matrix diffusion. In the case of surface sorption five input parameters and for matrix diffusion six input parameters were varied. The results of the uncertainty analyses are presented in the form of histograms, scatter plots, isocontour plots and 3-dimensional plots of the radionuclide release to the biosphere. Also the ten highest maximum release rates and correlation coefficients are presented.

380 **(TGL—190-921/01) Centralized collection of radioactive wastes. Terms and definitions.** (VEB Kernkraftwerk Bruno Leuschner, Greifswald (German Democratic Republic)). Jun 1985. 14p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703771/JAW.

The standard is based upon the regulation concerning the centralized collection and storage of radioactive wastes of 11 May 1981 and specifies the practical conditions and interactions during collection, transport, storage, and disposal of radioactive wastes. Part 01 defines the terms and general requirements, kinds of collection services, requirements for packaging and containers, and gives examples of a protocol of delivery/acceptance and of transport documentation.

381 **(TGL—190-921/02) Centralized collection of radioactive wastes. Solid wastes, waste category A1, radiation protection groups S1 and S2.** (VEB Kernkraftwerk Bruno Leuschner, Greifswald (German Democratic Republic)). Jun 1985. 4p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700133/JAW.

The standard based upon TGL-190-921/02 applies to solid wastes of the category A1 and the radiation protection groups S1 and S2. The following items are specified: (1) requirements concerning the form and properties of the waste (permitted composition, unpermitted components, type of packaging, maximum weight per package/container), (2) technical conditions for connecting technical means of collection (lifting devices, traffic connections) with customer, and (3) tasks in handing/taking over the waste in relation to waste type (controls, operation of facilities, decontamination, transport documents).

382 **(TGL—190-921/03) Centralized collection of radioactive wastes. Solid wastes, waste category A1, radiation protection groups S3, S4, and S5.** (VEB Kernkraftwerk Bruno Leuschner, Greifswald (German Democratic Republic)). Jun 1985. 3p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700134/JAW.

The standard based upon TGL-190-921/03 applies to solid wastes of the category A2 and the radiation protection groups S3, S4 and S5. The following items are specified: (1) requirements concerning the form and properties of the waste (permitted composition, unpermitted components, type of packaging, maximum weight per package/container), (2) technical conditions for connecting technical means of collection (lifting devices, traffic connections) with customer, and (3) tasks in handing/taking over the waste in relation to waste type (controls, operation of facilities, decontamination, transport documents).

383 **(TGL—190-921/04) Centralized collection of radioactive wastes. Liquid wastes, waste category A2, radiation protection groups S1 and S2.** (VEB Kernkraftwerk Bruno Leuschner, Greifswald (German Democratic Republic)). Jun 1985. 3p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700135/JAW.

The standard based upon TGL-190-921/04 applies to liquid wastes of the category A2 and the radiation protection groups S1 and S2. The following items are specified: (1) requirements concerning the form and properties of the waste (permitted composition, unpermitted components, type of packaging, maximum weight per package/container), (2) technical conditions for connecting technical means of collection (pumps, lifting devices, traffic connections) with customer, and (3) tasks in handing/taking over the waste in relation to waste type (controls, operation of facilities, decontamination, transport documents).

384 **(TGL—190-921/05) Centralized collection of radioactive wastes. Sealed sources of waste category A3, radiation protection groups S1 to S4.** (VEB Kernkraftwerk Bruno Leuschner, Greifswald (German Democratic Republic)). Jun 1985. 3p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700136/JAW.

The standard based upon TGL-190-921/05 applies to spent sealed sources of the waste category A3 and the radiation protection groups S1 to S4. The following items are specified: (1) requirements concerning the form and properties of the waste (permitted composition, unpermitted components, type of packaging, maximum weight per package/container), (2) technical conditions for connecting technical means of collection (lifting devices; traffic connections) with customer, and (3) tasks in handing/taking over the waste in relation to waste type (controls, operation of facilities, decontamination, transport documents).

385 **(TUBIK—61) Study on the sorption of uranium in the Gorleben groundwater-sediment regime.** Koss, V. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Kerntechnik). Dec 1986. 67p. (In German). NTIS, PC E09; NTIS as TIB/B87-11593.

A model is presented describing the sorption of uranium in the Gorleben groundwater-sediment regime. Based on experimentally derived data, the model also takes into account values of the surface complex model. Computer calculations were made with the geochemical MINEQL code. The model developed yields information about the parameters of the uranium sorption process, the decisive factors being carbonate concentration and pH value of the groundwater and cation exchange capacity of the sediment. An equation is given describing the sorption process in the oxydising milieu of the Gorleben regime, taking uranium complex formation into account.

386 **(UCRL—94659) Spent fuel as a waste form: Data needs to allow long term performance assessment under repository disposal conditions.** Oversby, V.M. (Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 17p. (CONF-861207—115). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013824/JAW.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Performance assessment calculations are required for high level waste repositories for a period of 10,000 years. The Siting Guidelines require a comparison of sites following site characterization and prior to final site selection to be made over a 100,000 year period. To perform the required calculations, a detailed knowledge of the physical and chemical processes that affect waste form performance will be needed for each site. This paper will review the factors that affect the release of radionuclides from spent fuel under repository conditions, summarize our present state of knowledge, and suggest areas where more work is needed to support the performance assessment calculations. 17 refs., 5 figs., 3 tabs.

387 **(UCRL—95961) Copper corrosion in irradiated environments: The influence of H_2O_2 on the electrochemistry of copper dissolution in HCl electrolyte.** Smyrl, W.H.; Bell, B.T.; Atanasoski, R.T.; Glass, R.S. (Lawrence Livermore National Lab., CA (USA); Minnesota Univ., Minneapolis (USA); Belgrade Univ. (Yugoslavia). Inst. of Electrochemistry). Dec 1986. Contract W-7405-ENG-48. 13p. (CONF-861207—116). NTIS, PC A02. Order Number DE88000419/JAW.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The anodic dissolution of copper was examined in deaerated, 0.1 M HCl aqueous solution in the presence of H_2O_2. Concentrations of H_2O_2 up to 0.2 M were studied at a rotating copper disk-platinum ring electrode. The open circuit potential (OCP) of copper was found to depend on both peroxide concentration and rotation rate. The OCP shifts towards more positive values with increasing H_2O_2 concentration (C) and decreasing rotation rate. The current-voltage curves for anodic dissolution of copper were also influenced by the presence of peroxide. The curves recorded with the potential scanned in the positive direction showed the expected 60 mV slope, but the reverse scans showed significant departures. At a given potential scan rate, hysteresis was observed which was larger for higher H_2O_2 concentrations, lower rotation rates, and more positive anodic potential limits. Monitoring the cuprous ions at the outer Pt ring revealed that there was a complex set of events taking place at the copper surface, including film formation and the appearance of cupric ions. 13 refs., 7 figs.

388 **(UCRL—96318) Electromagnetic experiment to map in situ water in heated welded tuff: Preliminary results.** Ramirez, A.L.; Daily, W.D. (Lawrence Livermore National Lab., CA (USA)). 16 Mar 1987. Contract W-7405-ENG-48. 12p. (CONF-870625—18). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000241/JAW.

From 28. U.S. symposium on rock mechanics; Tucson, AZ, USA (29 Jun 1987).

An experiment was conducted in Tunnel Complex G at the Nevada Test Site to evaluate geotomography as a possible candidate for in situ monitoring of hydrology in the near field of a heater placed in densely welded tuff. Alterant tomographs of 200 MHz electromagnetic permittivity were made for a vertical and a horizontal plane. After the 1 kilowatt heater was turned on, the tomographs indicated a rapid and strong drying adjacent to the heater. Moisture loss was not symmetric about the heater, but seemed to be strongly influenced by heterogeneity in the rock mass. The linear character of many tomographic features and their spatial correlation with fractures mapped in boreholes are evidence that drying was most rapid along some fractures. When the heater was turned off, an increase in moisture content occurred around the heater and along the dry fractures. However, this process is much slower and the magnitude of the moisture increase much smaller than the changes observed during heating of the rock. The interpretation of the tomographs is preliminary until they can be processed without the restrictive assumption of straight ray paths for the signals through the highly heterogeneous rock mass. 15 refs., 4 figs.

389 **Scanning electron microscope method for rock-varnish dating.** Harrington, C.D.; Whitney, J.W. (Los Alamos National Lab., NM; US Geological Survey, Denver, CO). *Geology;* **15**: 967-970(Oct 1987).

Rock-varnish coatings on cobbles from geomorphic surfaces and exposed deposits in arid environments are an effective medium for dating over a time range of several thousand to a few million years. A new analytical method for dating of rock varnish is presented wherein the varnish cation ratio (VCR) is determined by a scanning electron microscope (SEM) equipped with an energy dispersive x-ray analyzer (EDAX). The experimental SEM method is a nondestructive technique that has several potential advantages over the original method of analysis, described by R.I. Dorn, that uses particle-induced x-ray emission (PIXE) of varnish scraped from rock surfaces. The SEM method can potentially eliminate analytical errors due to contamination from rock substrate because variations in varnish thickness and irregularities on the substrate surface are examined before cation ratios are determined. Because varnish surfaces remain intact, varnish sites that yield anomalous results may be reanalyzed or verified. In addition, the general accessibility of scanning electron microscopes will make rock-varnish dating more widely available for use in Quaternary studies. Cation ratios were calculated for rock varnish from Espanola Basin, New Mexico, and the Yucca Mountain region, Nevada, and were used to construct rock-varnish dating curves for these areas.

390 **Disposing of nuclear waste: an economic analysis of two alternative concepts.** Dippold, D.G.; Tzemos, S. (Battelle Columbus Div., OH). *International Journal of Energy Systems;* **7**: No. 1, 10-14(1987).

WADCOM II is a nuclear waste disposal cost model intended to provide its users with relatively quick, although macro, insight into the economics of hypothetical nuclear waste disposal scenarios. The nuclear waste management system represented by the model, the philosophy underlying the model's design, and the logic of the model itself are described. The model is used to analyze the economics of two nuclear waste disposal concepts, the borehold package concept and the generic package concept. Results indicate the generic package concept leads to the higher costs under all the assumed conditions.

391 **Corrosion of iron-base waste package container materials in SALT environments.** Westerman, R.E.; Haberman, J.H.; Pitman, S.G.; Perrin, J.S. (Pacific Northwest Lab., Materials Science and Technology Dept., Richland, WA). pp 174-178 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—). Contract AC06-76RL01830.

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

Low-carbon ferrous materials are being considered for waste package container materials in high-level nuclear waste salt repositories. The short-term corrosion rates of ASTM Type A216 Grade WCA steel have been determined under both brine-only and moist-salt conditions at 150°C for times ranging from 1 to 12 months. Tests run in moist salt with low Mg content brine yielded relatively low corrosion rates, below and adjusted value of 0.032 mm (1.3 mils) per year at 150°C. Post-test examinations have shown that the corrosion product is a complex Fe-Mg hydroxide of amakinite structure, as opposed to the Fe/sub 3/O/sub 4/ observed in the low-Mg brines. The Mg content of the environment is believed to be a major factor leading to the higher corrosion rates and studies to understand the operative corrosion mechanisms are in progress.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 292, 294, 295, 297, 298, 301, 302, 303, 304, 308, 335, 336, 337, 338, 339, 340, 349, 350, 359, 360, 361, 362, 363, 365, 367, 368, 369, 370, 371, 372, 373, 374, 387, 388, 962, 972, 1428, 1826, 1828

392 **(DOE/DP—00539/058) Off-site environmental monitoring report: Radiation monitoring around United States Nuclear Test areas, Calendar year 1986.** Patzer, R.G.; Fontana, C.A.; Grossman, R.F.; Black, S.C.; Dye, R.E.; Smith, D.D.; Thome', D.J.; Mullen, A.A. (comps.). (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). May 1987. Contract AI08-76DP00539. 183p. (EPA—600/4-87-017). NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88000130/JAW.

The principal activity at the NTS is testing of nuclear devices, though other related projects are also conducted. The principal activities of the Off-Site Radiological Safety Program are routine environmental monitoring for radioactive materials in various media and for radiation in areas which may be affected by nuclear tests; and protective actions in support of the nuclear testing program. These are conducted to document compliance with standards, to identify trends, and to provide information to the public. 28 refs., 37 figs., 30 tabs.

393 **(IPNO-DRE—86-14) Long-term radiotoxicity of high level wastes and spent fuels produced by light water reactors: impact of burn-up extension and of the use of mixed oxide fuels.** Elayi, A.G.; Schapira, J.P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752700/JAW.

The time evolution of radiotoxicities of spent fuels and high-level wastes have been calculated up to 10/sup 7/ years, in the framework of the I.C.R.P.-30 guideline, except for neptunium and plutonium. For those elements, one has taken into account two recent modifications adopted in March 1986 by the International Commission on Radiological Protection, concerning a reduction by a factor 10 of the ratio dose/ingested activity for neptunium and an increase by the same factor for plutonium. In the case of burn-up extension of the standard 33,000 MWd/Mt enriched uranium fuel, and in the case of plutonium recycle in light-water reactors, one shows that the spent fuel radiotoxicity is now dominated by its plutonium content, up to about 10/sup 5/ years. Possible incineration effects are discussed within these two fuel cycle options.

0540 Health And Safety

REFER ALSO TO CITATION(S) 327, 343, 344, 386, 782, 891, 1612, 1751, 1780, 1941

394 **(AERE-R—12355) Removal of radiocaesium from urban surfaces contaminated as the result of a nuclear accident.** Sandalls, F.J. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Jan 1987. 98p. H.M. Stationery Office, London, price Pound 7.00.

Laboratory experiments were conducted in an effort to discover a non-destructive means of removing radiocaesium from the surface of a range of typical urban constructional materials (bricks, tiles, concrete, asphalt, painted timber etc) which might be contaminated as a result of an accident at a nuclear power plant. Water alone was found to be ineffective except on materials of very low specific surface area (e.g. glass). Treatment with dilute acid was effective on asphalt, Welsh slate and cement products but the latter suffered surface damage. The most useful means of decontamination was found to be treatment with an aqueous solution containing ammonium ion. In no case did surface damage occur and in some cases more than 90% of the caesium was removed. This technique was scaled-up and used in tests considered to be realistic with respect to decontamination of a typical urban area. Both steam-cleaning and sand-blasting tests were also conducted. Steam-cleaning was generally ineffective although there were some exceptions. Sand-blasting was always effective although of limited application on account of surface damage caused, non-containment of contaminated particulate waste and expense in terms of manpower.

395 **(DOE/ID/12584—4) Construction and testing of a blower-door assembly for regulation of air pressure within structures.** Steele, W.D. (UNC Geotech, Grand Junction, CO (USA)). Sep 1987. Contract AC07-86ID12584. 45p. (UNC/GJ—35-TMC). NTIS, PC A03. Order Number DE88000005/JAW.

The Technical Measurements Center is evaluating several methods to decrease the time required to determine an annual average radon-daughter concentration in structures. One method involves stabilizing the air pressure within the structure at a constant pressure with reference to external atmospheric or soil-gas pressure. This report describes the construction and preliminary testing of a blower-door system to maintain a constant differential air pressure within a structure. The blower-door assembly includes a collapsible frame and a large fan to occlude a doorway, a damper with an actuator to control air flow, a controller to drive the damper actuator, and a pressure transducer to measure the differential pressure. Preliminary testing of the system indicates that pressure within the structure in the range of 1 to 20 Pascals can be held to within approximately +-1 Pa of the set point. Further testing of the blower-door system is planned to provide data on the applicability of this method to short-duration tests for annual average radon-daughter concentration estimates. 13 figs., 1 tab.

396 **(IRD-CNEN-NT—011/86) National Inspection Program of Conventional Industries: implement, results and evaluation- 1981 to 1984.** Gloria, M.B.; Silva, F.C.A. da; Leocadio, J.C.; Valenca, J.R.M.; Farias, C. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1986. 26p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703598/JAW.

The methodology adopted by the Instutute of Radiation Protection and Dosimetry to implement the National Inspection Program of Conventional Industries is present. This methodology is being efficient because of many technical and administrative problems about radiation protection could be identified, analysed and solved gradually. Many workplaces of gammagraphy are analysed in relation to radiation safety, geographyc localization and social-economics aspects.

397 **(ORNL—6376) Evacuation: An assessment of planning and research.** Sorensen, J.H.; Vogt, B.M.; Mileti, D.S. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 234p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE87014963/JAW.

This research assesses issues and criticisms of evacuation planning for all hazards under an integrated emergency management concept and reviews research that addresses those issues. The work identifies gaps in knowledge about evacuation planning issues and research that can address these gaps. Over 300 documents were reviewed and abstracted, and key findings were summarized. Issues were identified by review of hearings, litigations, critiques, and discussions with planners and experts. Evacuation planning for some hazards has integrated physical risk studies with quantitative evacuation traffic modeling and behavioral research to produce comprehensive planning guidance. The adoption of an integrated or generic emergency management approach has bolstered and will further bolster the expediency of evacuation planning. Over the past ten years, most aspects of evacuation logistics have been defined and researched. There are indications that the local implementation of evacuation procedures has improved. People who could have evacuated to safety continue to die in disasters. Our research identified ten major issues in evacuation planning that cut across hazards. Planning for large-scale evacuations requires improvement. A better understanding of special evacuation planning needs for fast-moving events is needed. Evacuation planning for concurrent hazardous events is lacking. A better understanding of human behavior in evacuations is desirable. The accuracy of evacuation time estimates should be established. Guidelines on reentry after an evacuation should be improved. Special populations planning requires further investigation. Liability for evacuation decisions should be resolved. Uncertainties and problems in evacuation decision-making need greater attention. Adoption and implementation of integrated evacuation plans should be investigated. 222 refs., 12 figs., 6 tabs.

0550 Safeguards, Inspection, And Accountability

398 **(IAEA-STR—69-Rev.2) Destructive analysis and evaluation services.** Kuhn, E.; Lemaire, R.; Wenzel, U.; Aigner, H.; Bagliano, G.; Deron, S.; Jordan, L. (International Atomic Energy Agency, Vienna (Austria). Dept of Safeguards). Jul 1986. 104p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700113/JAW.

This manual describes the procedures for independent verification measurements by Destructive Analysis as required by the Divisions of Operations. It includes the relevant instructions and information necessary to achieve the verification from sampling through final use of the evaluation results. It is a working/reference document for the Inspectors and for the supporting units, as well as a training manual for Inspectors which brings together all the necessary information for verification by Destructive Analysis. This manual gives information essential to the Inspector and to the units of the Safeguards Analytical Services (SAS) in the following areas: material stratification, sampling, sample conditioning and data collection; packaging, transporting, tracking, receipt and analysis of samples; and evaluation and final use of the evaluation results. This information is provided as: specific instructions and/or examples; summaries of relevant, existing documents; and references to existing documents. Forms are available for sample, item and stratum data collection as well as for transfer of samples and for the reporting of results. A complete typical example package of the documents related to the verification by Destructive Analysis is included. In addition, summaries of the analytical procedures used at the Safeguards Analytical Laboratory (SAL) of the IAEA and the expected measurement performance for element assay and isotopic abundance are provided. Figs, tabs.

399 **(JAERI-M—86-167) Preliminary MUF analysis for a chemical process in the nuclear fuel cycle safety engineering research facility.** Ihara, Hitoshi; Nishimura, Hideo; Ikawa, Koji; Ichihashi, Yoshinori; Tachimori, Shoichi; Kobayashi, Iwao; Yamamoto, Tooru; Hisamatsu, Yoshinori. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 82p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703606/JAW.

The Nuclear Fuel Cycle Safety Engineering Research Facility (NUCEF), which is at the design stage, was planned for researches on the criticality safety at a nuclear facility, the safety at a reprocessing process, and the safety control system for TRU wastes with the aim of helping establish the self-sustaining technologies for the nuclear fuel cycle backend in Japan. In the A-building of this facility, a lot of nuclear materials, uranium and plutonium, is handled and there are such important processes as fuel dissolution, extraction, purification and evaporation as well as the criticality experimental device and the fuel storage equipment. Because of these characteristics, the facility will attract much concern in the field of safeguards, which necessitates to develop a nuclear material accountancy system so as to satisfy the goals of international safeguards as well as the requirements of SSAC. This report describes the results of MUF analysis for the chemical processes in the facility. The purpose of the analysis is to have a bird's-eye view on characteristics of the material accounting and control as a basis of the development of NUCEF material accountancy system.

400 **(LA-UR—87-2222) Variance calculations for materials accounting system design and evaluation.** Thomas, K.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870713—59). NTIS, PC A02. Order Number DE87013131/JAW.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Error propagation/variance calculations are used for establishing alarm limits for materials balance closures. Variance calculations may also be employed in the evaluation of accounting system designs for a proposed facility, as well as for upgrades of existing facilities. Information from such an exercise may be used to allocate resources for system improvements and identify process areas that require strict access or material controls. Simplifying assumptions are normally required since detailed data are not available for proposed facilities and may be difficult to obtain for existing facilities. Transfer, inventory, and measurement data are input into a code that calculates the variance for each term in the materials balance equation. Provision should be made for treatment of measurement correlations and holdup. The results are analyzed to determine major contributors to the total materials balance area (MBA) variance. A sensitivity analysis may be performed to determine the effect of changes in the measurements, measurement errors, or MBA structure. Examples of how variance calculations are used in accounting system analysis are discussed in the paper.

401 **(RFP—4065) Security computer system.** Macklin, L.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 6 Jul 1987. Contract AC04-76DP03533. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000711/JAW.

The main fire and security alarm system has been upgraded using modern redundant computers and ergonomic graphic presentation techniques. The system provides continuous alarm monitoring and record keeping for as many as 4000 alarm points. It is capable of simultaneous guard tour and test/reset tour monitoring.

402 **(SAND—87-2279C) An identity verifier evaluation of performance.** Maxwell, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 26p. (CONF-8710162—1-Vugraphs). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014850/JAW.

From Smart card conference; Atlantic City, NJ, USA (12 Oct 1987).

Because the development of personnel identity verifiers is active in several areas, it is important that an independent comparative evaluation of such devices be continuously pursued for the security industry to apply such devices. An evaluation of several verifiers was recently conducted (in the winter of 1986/1987) at Sandia National Laboratories. In a nonrigorous attempt to comparatively evaluate these verifiers in a field security environment, about 80 individuals were enrolled in five different verifiers. The enrollees were than encouraged to attempt a verification on each device several times a day for about four months such that both single try and multiple try information could be extracted from the data. Results indicated a general improvement in verifier performance with

regard to accuracy and operating time compared to previous similar evaluations of verifiers at Sandia.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 301, 362, 380, 381, 382, 383, 384, 749

403 **(INIS-XN—77) Agreement between the Government of Canada and the Government of the Republic of Turkey for co-operation in the peaceful uses of nuclear energy.** (International Atomic Energy Agency, Vienna (Austria)). 18 Jun 1985. 15p. (In English, French and Turkish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700120/JAW.

Published in Resmi Gazete.

By Act No. 3258 of 11 February 1986 the Turkish National Assembly approved ratification of the Agreement of 18 June 1985 between the Government of Turkey and the Government of Canada for Co-operation in the Peaceful Uses of Nuclear Energy. The Agreement covers nuclear co-operation in industry agriculture, electricity generation, etc, and provides the legal framework for such co-operation. It lays down the general provisions for transfer of nuclear facilities, materials and technology between the two Parties and specifies the areas concerned. The Agreement provides that all the activities within its scope shall be carried out for exclusively peaceful purposes. (NEA).

404 **(INIS-XN—79) Decree No. 86-1103 of 2 October 1986 on protection of workers against the hazards of ionizing radiation.** (International Atomic Energy Agency, Vienna (Austria)). 12 Oct 1986. 42p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700121/JAW.

Published in the Journal Officiel de la Republique Francaise.

This Decree repeals and replaces the Decree of 15th March 1967 on protection of workers against the hazards of ionizing radiation. Like the 1967 Decree, this Decree does not apply to major nuclear installations, including those classified as secret. The purpose of the 1986 Decree is to implement in domestic legislation the Euratom Directive of 15th July 1980, amended by the Directive of 3rd September 1984, to take into account developments in labour laws - in particular as regards the role of committees responsible for health, safety and working conditions and technology. Finally, it covers all work involving ionizing radiation, including agricultural activities. (NEA).

405 **(INIS-XN—80) Act No. 84 amending the decision of the Ministry of Communications on Transport of Dangerous Substances by Road.** (International Atomic Energy Agency, Vienna (Austria)). 2 Feb 1987. 28p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700122/JAW.

This Act amends Decision No. 610 of 1978 of the Ministry of Communications on the Transport of Dangerous Substances by Road, which also covers radioactive substances; the amendments in their respect set out in the Annexes are of a technical nature. The Act entered into force on 1 April 1987. (NEA).

406 **(PB—87-215869/XAB) Final Regulatory Impact Analysis 40 CFR (Code of Federal Regulations) Part 191: environmental standards for the management and disposal of spent nuclear fuel, high-level, and transuranic radioactive wastes. Final report.** (Office of Radiation Programs, Washington, DC (USA)). Aug 1985. 53p. (EPA—520/1-85/027). NTIS, PC A04/MF A01.

This Final Regulatory Impact Analysis (RIA) addresses the requirements of Section 2 of Executive Order No. 12291. It reviews the projected costs associated with management and disposal of the high-level radioactive wastes (or spent nuclear fuel) generated by nuclear power plants. It then evaluates the potential effects on the program for mined geologic repositories, as called for by the Nuclear Waste Policy Act of 1982 (NWPA), of the Agency's final environmental standards for disposal of these wastes.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

407 **(PNL—6361) List of DOE radioisotope customers with summary of radioisotope shipments, FY 1986.** Lamar, D.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 51p. NTIS, PC A04. Order Number DE88001694/JAW.

This document describes radioisotope distribution from DOE facilities to private firms including foreign and other DOE facilities. The information is divided into five sections: (1)isotope suppliers, facility contact, and isotopes or services supplied; (2) customers, suppliers, and isotopes purchased; (3) isotopes purchased cross-referenced with customer numbers; (4) geographic locations of radioisotope customers; and (5) radioisotope sales and transfers for fiscal year 1986.

0701 Physical Isotope Separation

408 **(CNEA-NT—15/84) Direction of Heavy Water Projects. Summary of activities 1950-1983.** (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Direccion de Proyectos de Agua Pesada). Jul 1984. 114p. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700109/JAW.

Summary of the activities performed by the Heavy Water Projects Direction of the Argentine Atomic Energy Commission from 1950 to 1983. It covers: historical data; industrial plant (based on ammonia-hydrogen isotopic exchange); experimental plant (utilizing hydrogen sulfides-water process); Module-80 plant (2-3 tons per year experimental plant with national technology) and other related tasks on research and development (E.A.C.). Contains lists of 79 internal reports about physical chemistry in relation to heavy water published from 1975 to 1983 and 13 bibliographical refs.

409 **(MPQ—106) Laser-induced thermal diffusion.** Scholz, M. (Max-Planck-Institut fuer Quantenoptik, Garching (Germany, F.R.)). Jan 1985. 127p. (In German). NTIS, PC E11; NTIS as TIB/B87-11109.

The concept of laser-induced thermal diffusion was investigated by using a separation column in which a laser beam was axially directed. This serves the same function as the heating wire normally employed in the Clusius-Dickel method. The experimental runs used Ar-SF/sub 6/ mixtures to observe separation effects. The measurements show a dependence on upward or downward direction of the beam and best results were obtained by changing the direction during the run. Separation factors were measured as function of pressure, beam diameter, radius of the column and laser power. Theoretical predictions could be confirmed within a factor of 2. The best separation factor found was superior by a factor of $\geqq 5$ as compared to a wire-heated Clusius-Dickel column. For the separation of isotopes the apparatus would need improvement and scaling in both length and laser performance. The separation of azeotropic mixtures is possible and the concept lends itself to the study of laser-induced chemical reactions where thermolabile products have to be removed from the heated zone. (orig./HOK).

410 **Measurement of the beam energy spread from a microwave ion source.** Chamberlin, E.P.; Leung, K.N.; Walthers, S.; Bibeau, R.A.; Stice, R.L.; Kelley, G.M.; Wilson, J. (Los Alamos National Lab., Los Alamos, NM 87545). pp 227-234 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—).

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

A 2.45 GHz microwave ion source has been tested on the Los Alamos National Laboratory 55° isotope separator. The advantages of the traditional RF ion source (high ionization efficiency and low gas consumption) are retained. In none of the tests was there evidence of energy spread resulting from the oscillatory field.

411 **A new high-temperature plasma ion source for the TRISTAN ISOL facility.** Piotrowski, A.; Gill, R.L.; McDonald, D.C. (Brookhaven National Lab., Upton, NY 11973). pp 249-252 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—). Contract AC02-76CH00016.

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

A vigorous program of ion-source development at TRISTAN has led to several types of ion sources that are especially suited to extended operation at a reactor-based ISOL facility. The latest of these is a high-temperature plasma ion source in which a 5-g /sup 235/U target is located in the cathode and can be heated to 2500°C. The ion source has a lifetime of > 1000 h and produces a wide array of elements, including palladium. Off-line investigations indicate that the source functions primarily in an electron impact mode of ionization and exhibits typical ionization efficiencies of > 30% for xenon.

412 **The time-of-flight isochronous (TOFI) spectrometer for direct mass measurements of exotic light nuclei.** Wouters, J.M.; Vieira, D.J.; Wollnik, H.; Butler, G.W.; Kraus, R.H. Jr.; Vaziri, K. (Los Alamos National Lab., Los Alamos, NM 87545). pp 286-293 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—).

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

A new type of time-of-flight recoil spectrometer designed to measure the masses of neutron-rich light nuclei has recently been completed at LAMPF. The spectrometer relies on an isochronous design that directly correlates an ion's time-of-flight through the spectrometer with its mass-to-charge ratio. Additional measurements of the ion's velocity and energy enable the charge state of the recoil to be uniquely defined and thus permit precision mass measurements given sufficient statistics. The performance of the spectrometer has been investigated in both off-line (using alpha sources) and on-line tests. The design resolution of $\Delta M/M = 1/2000$ (fwhm) has been achieved. Initial performance results of the spectrometer are described with emphasis placed on the techniques used to achieve the overall high mass resolution and large solid angle/momentum acceptance.

413 **Performance of the reaction-product transport line associated with the TOFI spectrometer.** Vaziri, K.; Wohn, F.K.; Vieira, D.J.; Wollnik, H.; Wouters, J.M. (Utah State Univ., Logan, UT 84322). pp 280-285 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—).

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

A reaction-product transport line with a solid-angle acceptance of 2.8 msr and a momentum-to-charge acceptance of 28% has been constructed to deliver neutron produced in heavy-target fragmentation reactions to the time-of-flight isochronous (TOFI) spectrometer. The design and performance of the transport line, which incorporates a mass-to-charge filter to reduce the rate of uninteresting ions entering the spectrometer, is described.

414 **Improvements to the helium-jet coupled on-line mass separator RAMA.** Blonnigen, F.B.; Moltz, D.M.; Lang, T.F.; Knoll, W.F.; Xu, X.; Hotchkis, M.A.C.; Reiff, J.E.; Cerny, J. (Dept. of Chemistry and Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 328-332 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—). Contract AC03-76SF00098.

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

Some general improvements to the on-line mass separator RAMA have yielded a factor of five increase in yield for most elements. By placing the ion-source region at the full accelerating potential of 20 kV, the effective skimmer-plasma distance has been reduced from 12 to < 2 cm. Changes in the helium-jet chamber and large-volume pumping arrangement necessitated by placing the ion-source region at high voltage are also given. Finally, details for a new highly-shielded detector station are presented.

415 **Ion-source development at the /sup 252/Cf ISOL facility.** Anderl, R.A.; Cole, J.D.; Greenwood, R.C. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415). pp 333-340 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—). Contract AC07-76ID01570.

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

The ISOL system at the INEL utilizes the He-gas-jet techniques to transport fission products from /sup 252/Cf spontaneous-fission sources to the ion source of an electromagnetic mass separator. A long-lived, gas-jet-coupled ion source for production of rare-earth fission-product ion beams has been developed and implemented in this system. This paper describes the ion source, its operating parameters and its implementation in the search for new rare-earth element isotopes. New isotopes observed, with preliminary values of their half-lives in parentheses, are /sup 153/Pr(4.2 s). /sup 155/Nd(8.9 s). /sup 156/Nd(5.5 s), /sup 157/Pm(10.9 s). /sup 158/Pm(4.3 s) and /sup 162/Eu(11.0 s). Total separation efficiencies (based on the ratio of radionuclide activity collected at the focal plane of the mass separator to radionuclide activity generated by the /sup 252/Cf source) were estimated to be approximately 1% for /sup 154/Pm and 1% for /sup 158/Sm.

416 **Optimization of a He-jet activity transport system to use at LAMPF.** Talbert, W.L. Jr.; Bunker, M.E.; Starner, J.W. (Los Alamos National Lab., Los Alamos, NM 87545). pp 345-350 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—).

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

As part of an assessment of the feasibility for a He-jet coupled on-line mass separator at LAMPF, the authors have studied performance characteristics of a gas activity transport system under conditions simulating those expected on the main LAMPF beam line. In experiments utilizing a side beam at LAMPF, they have measured absolute transport efficiencies, transit times, aerosol properties, and dependence on beam intensity. Further experiments with a He-jet system at the Omega West Reactor have indicated an optimum configuration of a target chamber to be placed in the LAMPF main beam. The results of these studies suggest that a He-jet activity transport system should work well at LAMPF in the 800-MeV, 1-mA proton beam that is spread over — 40 cm/sup 2/ near the beam stop.

417 **Ion-optical design for an on-line mass separator at LAMPF.** Talbert, W.L. Jr.; Wollnik, H.; Geisse, C. (Los Alamos National Lab., Los Alamos, NM 87545). pp 351-353 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—).

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

A two-stage isotope separator is proposed to operate on-line with a He-jet coupled ion source labelled at LAMPF. As a special feature, the design of this separator employs a preseparation stage to remove the intense He/sup -/ component of the ion source output. This feature allows the low-intensity radioactive ion beam to be transported throughout the two separator stages, and at the same time makes possible monitoring and control of the ion source performance. A design goal is to achieve a resolving power suffi-

cient to provide isobar separation for nuclei far from stability, especially important because of the elemental nondiscrimination obtained using the He-jet approach.

418 **A completely cold laser ion source for separators.** Fairbank, W.M. Jr.; Carter, H.K. (Physics Dept., Colorado State Univ., Fort Collins, CO 80523). pp 357-361 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—).

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

A new type of laser ion source is proposed for the UNISOR isotope separator. Products from heavy-ion reactions are stopped in helium gas and transported to a cold collector. After a collection period, the sample is desorbed by a pulsed laser beam. A second laser ionizes the atoms of interest in the vapor cloud. The ions are extracted and sent through the separator. Recent analytical applications of resonant and nonresonant ionization indicate that a total efficiency of 1-10% should be achievable.

419 **Ion source for isotope separators.** Shubaly, M.R. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). pp 195-203 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—).

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

To assist in the technology transfer from the field of high-current accelerator sources to isotope separators, advances in three areas are described. First, the design of extraction electrodes to provide high-quality, high-current beams is discussed. Then, two new ion-source designs for high-current beams of nonvolatile elements are described. Finally, two electronic systems that have significantly improved the reliability of ion-beam systems are presented.

420 **Status report on 126° isotope separator construction.** Chamberlin, E.P.; Balagna, J.P.; Camplan, J.; Kelley, G.M.; Bibeau, R.A.; Rios, E.L.; Stice, R.L. (Los Alamos National Lab., Los Alamos, NM 87545). pp 21-24 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—).

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

Two new isotope separators are being constructed at the Los Alamos National Laboratory (LANL) Isotope and Nuclear Chemistry Division. The system design was a joint effort between Laboratoire Rene Bernas and LANL. Design goals included constant dispersion capability with M/M + 1 separation of 18 mm at M=250 amu. The separator magnets have the following parameters: rho=1460mm, phi=126°, $0.42 \leqq n \leqq 0.585$, gap=137mm.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 1642

421 **(IAEA-RL—139) Nuclear analytical techniques for mineral exploration, mining and processing plants. Working papers prepared in connection with the final research co-ordination meeting held in Melbourne, Australia 3 to 7 November 1986.** (International Atomic Energy Agency, Vienna (Austria)). 1987. 225p. (CONF-8611195—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW.

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

This volume is the final report from the Coordinated Research Programme and consists primarily of the research reports presented at the third meeting of the participants. The participants of the meeting considered and discussed progress and achievements made during the last three years: systems for in-stream analysis of mineral slurries, on-line determination of ash in coal using low energy gamma rays transmission and pair production techniques, in-stream determination of solids weight fraction and ash content of coal in slurries, on-line determination of moisture in coal, iron in high grade iron ores and sulfur in lead sinter, developed and tested a borehole logging system based on the spectrometric gamma-gamma method in coal, iron ore and manganese deposits, the results from the NAA and XRF analysis of the tailings and slurries exhibit the potentiality of nuclear analytical techniques in the various stages of the mining industry. A separate abstract was prepared for each of the 12 papers in this volume. Refs, figs and tabs.

422 (IAEA-RL—139, pp 55-60) **Determination of moisture in black coal using pulsed nuclear magnetic resonance spectrometry.** Cutmore, N.G.; Sowerby, B.D.; Lynch, L.J.; Webster, D.S. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Mineral Engineering). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

Pulsed nuclear magnetic resonance (NMR) spectrometry was investigated as a technique for moisture determination in fine product coal from eight Australian coal washeries. Measurements were made on samples of diameter 8 and 12 mm and length 10 and 120 mm at frequencies from 6.5 to 60 MHz. The ratio of intensities of the water and coal components in the free-induction decay signal can be used to determine moisture to within approx. 0.4-0.7 wt% over the range 0-26 wt% moisture, independent of sample density. This accuracy is independent of particle size (up to 1 mm) and little affected by coal rank, sample length or n.m.r. frequency. 11 refs, 6 figs, 3 tabs.

423 (IAEA-RL—139, pp 61-88) **Under-belt capacitance and γ-ray backscatter gauge for on-line determination of moisture in coal.** Cutmore, N.G.; Roczniok, A.F.; Sowerby, B.D. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Mineral Engineering). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

A non-contacting under-belt capacitance and γ-ray backscatter technique has been developed for on-line measurement of moisture in coal. In this technique, moisture was correlated with radio-frequency susceptance and conductance, determined using an under-belt capacitance sensor in which a fringing electric field interrogates a layer of coal on the conveyer belt directly above the sensor. To compensate for variation in the density and thickness of the coal layer an under-belt gamma-ray backscatter gauge was used to measure an equivalent volume of coal. Laboratory measurements have shown that this technique compensates more accurately for density and thickness than does their direct physical measurement. In laboratory measurements on five samples of coke oven feed a mean r.m.s. error of 0.45 wt% moisture was obtained for the thickness range 25 to 75 mm and moisture range 0 to 15 wt%. For reduced thickness ranges the r.m.s. error was reduced to 0.27 wt% moisture. For fine particle size coal (filtercake and spiral product) the mean r.m.s. error was 0.31 wt% for samples of thickness 45 to 70 mm and moisture 15 to 30 wt%. In a recent field trial of the technique at Stockton Borehole Colliery, NSW, Australia, r.m.s. errors of 0.50 and 0.25 wt% moisture were obtained for on-belt and static off-belt measurements respectively. 12 refs, 6 figs, 5 tabs.

424 (IAEA-RL—139, pp 89-96) **Nuclear techniques for on-line analysis in mineral and coal processing.** Cutmore, N.G.; Sowerby, B.D.; Watt, J.S.; Holmes, R.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Mineral Engineering; Commonwealth Scientific and Industrial Research Organization, Port Melbourne, Australia. Div. of Mineral Engineering). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

Major improvements have taken place in mineral and coal processing in the last decade. The development of nuclear on-line sensors that continuously analyse the material being processed has led to better control of metalliferous mineral processing and increased recovery of valuable minerals. The recent development of on-line techniques for analysis of coal is expected to be of similar importance. Australian developments in on-line nuclear gauges are reviewed. These include systems for in-stream analysis of mineral slurries with comments on plant operating experience; on-line determination of ash in coal using low energy γ-ray transmission and pair production techniques; in-stream determination of solids weight fraction and ash content of coal in slurries with variable voidage; and on-line determination of moisture in coal, iron in high grade iron ores and sulphur in lead sinter. 16 refs, 9 figs.

425 (IAEA-RL—139, pp 181-196) **On the possibility of application of EDXRF method for particle-size control of multimetallic ores.** Holynska, B.; Lankosz, M. (Institute of Physics and Nuclear Techniques, Krakow, Poland). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

The possibility of using an EDXRF method for particle-size control of multimetallic ore slurry has been studied. Zinc-lead-iron ore slurry has been chosen as an example of multimetallic specimens. The influence of metals concentration, solids content and parameters of grain-size distribution on the accuracy of the method has been calculated. The proposed method was checked experimentally with the use of samples simulating Zn-Pb ore slurries. 6 refs, 11 figs, 4 tabs.

426 (IAEA-RL—139, pp 197-209) **On-stream XRF measuring system for ore slurry analysis and particle-size control.** Holynska, B.; Lankosz, M.; Ostachowicz, J. (Institute of Physics and Nuclear Techniques, Krakow, Poland). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

The radioisotope X-ray fluorescence measuring system has been developed for on-stream determination of major elements in mineral slurry as well as for continuous particle-size control. The system consists of several immersion gauges, particle size analyser, electronic unit and computer for data processing. The system has been used for simultaneous determination of Fe, Zn, Pb in flotation streams with accuracy within 3-15% (1 relative standard deviation) (1 RSD)) depending on metal concentration. Accuracy of the determination of weight percentage of ore particles smaller than 75 μm amounted to 5% (1 RSD). 16 refs, 7 figs, 1 tab.

427 (IAEA-TECDOC—409, pp 133-135) **Application of reactor-produced radionuclides for industrial and environmental investigations.** Lehofer, K.; Biro, T. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

In this paper the application of radionuclides produced in the nuclear research reactor WWR-S as tracers for industrial and environmental process analysis is presented.

428 (MTB—176) **Study on the mechanical behavior of soil during frat edge cutting.** Ichiba, Satoru; Hyodo, Kazuya; Ooishi, Yoshihiro. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). Feb 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750063/JAW.

For the development of efficient earthmoving machinery, it is necessary to clarify the soil cutting mechanism, but there is no usual analytical or experimental technique for large deformation problems like soil cutting. Therefore, we have tried to apply the X-ray radiography method, which is a soil experiment method for the visualization and the quantitative analysis of soil deformation, to the flat edge cutting problem. Firstly we have confirmed that the X-ray radiography method is applicable to large deformations, and have examined by this method the cutting mechanism of soils under various cutting conditions. As a result, the behavior of shear failure lines, which have not been studied in detail before, are clarified, and the differences in the cutting mechanism with the cutting angle and the nature of soils are discussed through the quantitative estimation of the strain distribution.

429 (PTB-MM—4) **Proposed performance test of X-ray fluoroscopic equipment for quality assurance in diagnostic radiology.** Bronder, T.; Jakschik, J. (Physikalisch-Technische Bundesanstalt - Inst. Berlin (Germany, F.R.). Medizinische Messtechnik; Deutsche Gesellschaft fuer Medizinische Physik e.V., Berlin (Germany, F.R.)). Feb 1987. 61p. (In German). (DGMP—4). NTIS, PC E09; NTIS as TIB/B87-11474.

The DGMP-working group has established a test program by which it is possible to perform uniformly the performance test mentioned in DIN 6868, part 1 at fluoroscopic X-ray devices. The program has the following fundamental aims: 1) Uniformity of the testing extent, measuring conditions and test criteria. 2) Simple procedure of testing. 3) Definition of a reference dose rate ('transmission dose rate') by which the radiation exposure of the patient due to the given technical conditions can be characterized. 4) Definition of comparability criteria for dose rate measurements at fluoroscopic X-ray devices with different kinds of automatic dose rate control (mean value or maximum value). The conditions for the applicable measuring phantom and the measuring arrangement are deduced from these criteria. A model test program is presented for the most important single steps of a performance test. The practical trial of the test methods has revealed the possibility to get an evidental performance test in a fast and simple way by using suitable measuring devices.

430 **The availability of enriched stable isotopes: Present status and future prospects.** Hoff, R.W. (Nuclear Chemistry Div., Lawrence Livermore National Lab., Livermore, CA 94550). pp 1-6 of Electromagnetic isotope separators and techniques related to their applications. Talbert, W.L. New York, NY; Elsevier Science Pub. Co. Inc. (1987). (CONF-860815—). Contract W-7405-ENG-48.

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

The ORNL Electromagnetic Isotopic Enrichment Facility (EMIEF) has the foremost capability in the world for large-scale enrichment of stable isotopes. Despite the importance of these isotopes in research and medical applications, the funding levels for EMIEF operation since 1982 have decreased significantly, forcing operation at rates far below replacement of isotopes sold or loaned. The availability of enriched stable isotopes is presented, along with a summary of EMIEF User Group concerns and activities.

0704 Economics

REFER ALSO TO CITATION(S) 430

08 Production

REFER ALSO TO CITATION(S) 556, 1011, 1983

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 1659

431 (ANL/CNSV-TM—173, pp 47-55) **Landfill gas recovery, processing, and sale: an overview.** Paul, M.P. (GSF Energy, Inc., Signal Hill, CA). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

The purpose of this paper is to very briefly describe landfill gas, the environmental concerns associated with its emission from landfills, the technology utilized to recover and process the gas, the benefits resulting from such activity, and the current regulatory and economic issues which provide both incentives and obstacles to the development of these facilities. Landfill gas (Lfg) is created naturally in the landfill by the anaerobic decomposition of organic materials in the refuse. This decomposition converts the organic material into a gaseous form. In its raw state, Lfg consists of approximately 55% non-reactive methane gas and 44% carbon dioxide.

432 (ANL/CNSV-TM—173, pp 82-86) **RefCOM commercialization program: anaerobic digestion.** Mooij, H.P. (RefCOM, Tampa, FL). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

The RefCOM Commercialization Program is the culmination of a developmental program which verified that the generation of methane gas from waste in a digestion process was of the same quantity and quality as established in laboratory testing. This technology has resulted in establishing criteria for the construction and operation of such a plant in the private sector, utilizing MSW and sewage sludge.

433 **(BMFT-FB-T—86-217) Investigation and optimization of biogas plants in operation with technical and economical comparison of the results. Development of design guidelines. Final report.** Perwanger, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bayerische Landesanstalt fuer Landtechnik, Freising (Germany, F.R.)). Dec 1986. 374p. (In German). NTIS (US Sales Only), PC A16/MF A01. Order Number DE87753253/JAW.

This research report documents the results of the work done from 1982 to 1986 with the following main points: 1.) Description of 28 biogas plants under research and their way of functioning partly with description of building, operation mode, investment and costs of operation and performance data. 2.) Comparison of the results of these plants concerning the gas production, gas quality and process energy. Presentation of the amount of work, the investment and the costs of maintenance and repair. Determination of the net energy costs. 3.) Presentation of the results of parallel performed laboratory experiments with several continuous biogas plants (2,2-2,0 m/sup 3/), 80 batch type plants (5 l) and 2 storage plants (200 l) under different experimental conditions but with one substrate only. 4.) Design guidelines for biogas plants in a practical scale with 3 examples of optimization. With 125 refs., 19 tabs., 181 figs.

434 **(DOE/PC/70026—T1) Carbonaceous overlayers precursors on multimetallic catalysts and their relation to catalytic activity and deactivation: Final report.** Montano, P.A.; Cooper, B.R. (West Virginia Univ., Morgantown (USA). Dept. of Physics). 1984. Contract AC22-84PC70026. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE87010659/JAW.

We describe the details of implementation of the Film Linearized Muffin-Tin Orbital (FLMTO) method of Krakauer and Cooper for slab geometries. Using the constrained wave functions as described by Krakauer and Cooper, we get consistently good results except for the work function. We describe an alternate method that we have also implemented to improve the work function. This discards the Plane Wave Orbitals while striving to improve the quality of the basis functions for describing the vacuum behavior without increase in matrix sizes. We find the quality of results poorer. Therefore, in the Appendix, we suggest a way of increasing the variational freedom by removing the constraint on the Plane Wave Orbitals. The experimental section deals with three different systems. The first consists in the study of a stable phase of fcc-Fe and their crystallographic and electronic properties. This is a novel an unique material which is characterized by a remarkable difference in electronic properties from the most commonly form of iron (bcc). The second part deals with a detailed investigation of the metal/support interaction using a MgO single crystal as the support and Fe as the Fischer-Tropsch catalyst. We performed a complete study of the electronic properties of this system and characterized the surface carbonaceous deposits by means of the Surface Extended Energy Loss Fine Structure (SEE LFS) Technique. The third part, a mixed metal Fischer-Tropsch catalyst Fe/Mn was studied by x-ray diffraction, Moessbauer spectroscopy and EXAFS. We determined the behavior of the catalysts on two supports silicate and alumina and identified the phases of Fe/Mn before, during and after reaction in CO/H_2. The following section give a detailed description of the experimental work.

435 **(DOE/PC/70030—T8) Novel Fischer-Tropsch slurry catalysts and process concepts for selective transportation fuel production: Quarterly technical progress report, 1 July 1985-30 September 1985.** Carroll, W.E.; Cilen, N.; Motika, S.A.; Withers, H.P. Jr. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Sep 1987. Contract AC22-84PC70030. 254p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88000434/JAW.

Four catalysts were prepared. Silica was examined as a support for the standard $Co_2(CO)_8/Zr(OPr)_4$ composition. A mixed Co/Fe catalyst on zirconated silica was prepared from $Co_2(CO)_8$ and $Fe_3(CO)_{12}$, rather than from the $[FeCo_2(CO)_{13}]^-$ anion. The use of Ti in place of Zr as the promoter was examined with the silica support. Further work on alternate supports was completed with the preparation of $Co_2(CO)_8$ and $Zr(OPr)_4$ on MgO 3.6SiO_2. Gas-phase screening was completed on three catalysts during the quarter. The effect of increasing the cobalt loading from 4 to 11 wt % for the $Co/Zr/Al_2O_3$ composition was to improve the bulk activity but lower the specific activity and to slightly shift the hydrocarbon selectivity to higher molecular weight products. The use of silica as a support for the mixed Co/Fe catalyst also provided an improvement in the Fischer-Tropsch activity but did not enhance the water-gas shift activity. Three catalysts were screened in the slurry reactor. A kinetic data analysis program was developed to aid in the analysis of catalyst data from the laboratory reactor tests operating at steady state. The required specifications include reaction stoichiometry and kinetics, the necessary reactor operating parameters, inlet conditions and gas phase product concentrations. Options include choice of fixing or fitting kinetic parameters and regressing rate coefficients in a normalized or standard fashion. Data from the catalyst slurry screening tests and more importantly the extended tests will be routinely analyzed for kinetic correlations. 5 refs., 50 figs., 105 tabs.

436 **(NP—7770273) Energy from municipal wastes - electric power generation on the basis of landfill gases. A contribution to pollution abatement.** Weingarten, I.; Roth, B. (Badenwerk A.G., Karlsruhe (Germany, F.R.)). 1986. 14p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770273/JAW.

Landfill gases are the product of the biochemical decomposition of municipal wastes disposed of in sanitary landfills. The uncontrolled escape of the gases impedes the growth of plants, develops unpleasant odors and may in some cases be bearing fire and explosion risks. The autorities do therefore require each sanitary landfill to collect the gases produced in gas collectors and burn them the most neutral way in burners or muffles. Their 40-50% methane content accounts for the high-energy quality of the gases produced. They are therefore predisposed for energetic uses. Any overconcentration of noxious components, however, may complicate or even impede the utilisation of landfill gases. There are two different ways of utilizing the gases: the generation of process heat and electric power generation with and without the transmission of heat (dual purpose power plants or cogeneration). Under certain conditions the energetic utilization of landfill gases, and electric power generation in particular, may be considered economic and contributes if only to a modest degree to electric power supplies or the preservation of resources, respectively. The utilization of landfill gases actively contributes to the protection of the environment by minimizing unpleasant odors and preventing our vegetation from being polluted with noxious substances. In contrast to futile burn-off processes it does also contribute to primary energy conservation.

437 **(PB—87-226825/XAB) Reduction of CO_2 to methanol and methane by photo and dark reactions on semiconductor and metal electrodes. Annual report, February 15, 1986-February 28, 1987.** Frese, K.W.; Summers, D.P.; Kim, J.J. (SRI International, Menlo Park, CA (USA)). 30 Apr 1987. 74p. NTIS, PC A04/MF A01.

See also PB—86-215712.

The electrochemical reduction of aqueous CO_2 was studied using Ru cathodes. The rate of methane formation is controlled by temperature, electrolyte pH, and impurities in the electrolyte. Electrode surfaces are deactivated at t greater than 80 C by formation of surface carbon. Methane formation is observed for potentials negative of -0.40V (SCE) at pH 4.0- is a poison for the methane reaction.

438 **Molecular characterization of the pyrolysis of biomass. 2. Applications.** Evans, R.J.; Milne, T.A. (Solar Energy Research Institute, Golden, CO (USA)). *Energy and Fuels;* 1: No. 4, 311-319(Jul-Aug 1987).

Molecular-beam mass spectrometric sampling (MBMS) is used to investigate several aspects of pyrolysis that are pertinent to practical conversion processes. The chemical nature of the collected oil is characterized, and four major types of pyrolysis liquids are identified and discussed. The effect of primary pyrolysis parameters on oil composition is discussed, and results show that physical effects such as particle size, moisture content, and heating rate have only secondary effects on the composition of the oil although the effect on yield may be dramatic. The gas-phase chemistry of conversion practices has been investigated from two perspectives; (1) attempts to upgrade the primary products such as continued pyrolysis in reactive environments such as methane and direct, low-pressure catalytic upgrading to aromatic gasoline; (2) the nature of emissions from high-temperature conversion devices such as gasifiers and combustors. Gas-phase pyrolysis of wood-derived vapors in methane has shown that olefins are enhanced, in accordance with literature reports. The direct catalytic upgrading of the wood-derived vapors over zeolites has shown the possibility of complete conversion of the primary products, although the yield of organic products has not yet been determined. The direct sampling of updraft and downdraft gasifier effluents has shown the nature of the condensible products, with the updraft producing primary oils and the downdraft producing tertiary, aromatic tars. A summary of the implications and future applications of this technique is given. 30 refs., 8 figs.

439 **Ethanol production during batch fermentation with Saccharomyces cerevisiae: changes in glycolytic enzymes and internal pH.** Dombek, K.M.; Ingram, L.O. (Univ. of Florida, Gainesville). *Applied and Environmental Microbiology;* 53: No. 6, 1286-1291(Jun 1987).

During batch fermentation, the rate of ethanol production per milligram of cell protein is maximal for a brief period early in this process and declines progressively as ethanol accumulates in the surrounding broth. The authors studies demonstrate that the removal of this accumulated ethanol does not immediately restore fermentative activity, and they provide evidence that the decline in metabolic rate is due to physiological changes (including possible ethanol damage) rather than to the presence of ethanol. Several potential causes for the decline in fermentative activity have been investigated. Viability remained at or above 90%, internal pH remained near neutrality, and the specific activities of the glycolytic and alcohologenic enzymes (measured in vitro) remained high throughout the batch fermentation. None of these factors appears to be causally related to the fall in fermentative activity during batch fermentation.

440 **Thermochemical conversion of high-moisture biomass feedstocks to methane-rich gas products.** Butner, R.S.; Sealock, L.J.; Elliott, D.C. (Pacific Northwest Lab., Richland, WA). pp 1645-1646 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

A low temperature biomass gasification concept for the gasification of high-moisture biomass feedstocks (>50% moisture) is under development at Pacific Northwest Laboratory (PNL). A one-liter batch reactor is being employed to determine the effectiveness of the concept, which uses a combination of pressure and catalysts to gasify biomass and produce a product gas which has a raw methane content (on a dry gas basis) of up to 53%. Commercially manufactured, alumina-supported nickel hydrogenation catalysts are used with and without alkali carbonate co-catalysts at reaction conditions of 400-450°C and 4000-5000 psig. Carbon conversion to gas is typically 80-90% after 15 minutes at temperature. The primary goal of the project is to demonstrate the technical viability of a process for the utilization of high moisture biomass. A second goal of the project is to demonstrate the advantages of a low temperature pressurized reactor for the production of methane from biomass.

441 **Evaluation of processes for removal of particulates, tars, and oils from biomass gasifier product gases.** Brown, M.D.; Baker, E.G.; Mudge, L.K. (Pacific Northwest Lab.). pp 655-676 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

For biomass gasification to make a significant contribution to the energy picture in the next decade, emphasis must be placed on the generation of clean, pollutant-free gas products. This paper attempts to quantify levels of particulates, tars, oils, and various other pollutants generated by biomass gasifiers of all types. Data from a bench-scale fluidized bed is presented which gives pollutant concentrations and compositions. End uses of biomass gases and appropriate gas cleaning technologies are examined. Complete systems analysis is used to predict the performance of various gasifier/gas-cleanup/end-use combinations. Further research needs are identified.

442 **Methanogens in digesters: Identification and quantification in microsamples by direct testing with antibody probes.** Macario, A.J.L.; Conway de Macario, E. (Wadsworth Center for Labs. and Research, New York State Dept. of Health, Albany, NY 12201). pp 1009-1020 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

Elucidation of the methanogenic flora in digestors will help to understand and optimize fermentation. Unfortunately, simple means for identifying methanogens are scarce. Usual enrichment-isolation procedures take time and are likely to alter the original bacterial distribution. The authors developed immunologic tools for rapid identification of methanogens by direct examination of samples. Bacterial cells, and antigens released by them into the fluid phase of digester mixtures, can be identified and measured avoiding isolation steps. Panels of poly- and monoclonal antibodies were assembled which detect methanogens and their released antigens in 10 μl samples. Identification is accomplished by complementary micromethods carried out on the reaction areas of a slide immunoenzymatic assay (SIA) designed for immunologic testing, differential staining and microscopic examination. Digester samples from various sources have been studied; Methanosarcinae, Methanobacteria, Methanobrevibacteria, Methanococcii and Methanothrix were found. Time-course studies to observe population shifts and to define immunotypes of interest are underway. A correlation of the immunologic findings with microbiologic, chemical, and engineering parameters should provide information for assembling antibody kits to monitor digestor function, and for improving process control and energy yields.

443 **Continuous anaerobic digestion of high solids biomass: Modeling and experiments.** Legrand, R.; Jewell, W.J. (Reynolds, Smith and Hills, P.O. Box 4850, Jacksonville, FL 32201). pp 1077-1096 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

A steady state mathematical model is presented, based on wet and dry mass balances and assuming a completely mixed reactor. It applies to all possible feeds and incorporates 1st order kinetics. Liquid can be extracted from the reactor effluent and recycled to the reactor. This is shown to allow considerable savings of heating energy, which is crucial to the efficient biogasification of dry substrates. The relationship between feed loading rate, hydraulic retention time and reactor solids concentration is established. With liquid recycle, two of these parameters can be chosen freely (2 degrees of freedom). This general framework can be used to develop alternative ways of digesting a given substrate, to quantify operational parameters and to optimize operation. Experiments with wheat straw demonstrate the bench-scale feasibility of liquid recycle, illustrate the use of the model and validate it. Four to five volumes of biogas per volume reactor per day were consistently produced, and recycled liquid satisfied most of the water addition needs. No salt or toxics accumulation should occur. In semi-continuous operation, the digesting slurry separates in two layers between batch feeding-mixings and the thickness of the floating solids layer is linearly proportional to the reactor solids concentration.

444 **Tropical macroalgal cultivation for bioconversion to methane.** Bird, K.T. (Div. of Applied Biology, Harbor Branch Foundation, Ft Pierce, FL 33450). pp 1283-1292 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

Several concepts have been developed for tropical marine biomass cultivation for bioconversion to methane. These concepts take advantage of Florida's large areas of relatively shallow water. One concept, tidal flat seaweed farms, uses currently available macroalgal candidates (Gracilaria, Ulva) and at biomass yields of 12-25 dry ash free tons/hectare-year can provide delivered low feedstock costs of $40-25/DAFT, or on an energy basis, $3.60-2.30/G joule, respectively. These biomass yields are close to those achieved in commercial Gracilaria culture in Taiwan. Such systems would be constrained to nearshore waters of 0.5-1.5 m in depth, of which there are 190,000 hectares in northwestern Florida. Concepts which would work in deeper waters (from 1.5-20 m depths) use floating seaweeds. Such biomass species need to be produced by genetic breeding and hybridization, as there is not an adequate natural species available which also has high bioconversion rates. Such hybrids may be intrageneric ones of Sargassum, or Sargassum hybrids with other algae such as Macrocystis. A biotechnology approach could provide competitive feedstock costs with a large potential gas production, as there is approximately 1,900,000 hectares between 1.5-20 m depths in northwestern Florida.

445 **Low-pressure upgrading of primary pyrolysis oils from biomass and organic wastes.** Diebold, J.P.; Chum, H.L.; Evans, R.J.; Milne, T.A.; Reed, T.B.; Scahill, J.W. (Solar Energy Research Institute, Golden, CO 80401). pp 801-830 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

Very rapid heating of oxygenated feedstocks, such as biomass and organic wastes, results in the fragmentation of the macromolecular polymers to produce 60 to 70 wt % primary vapor products composed of oxygenated monomers and polymer fragments. These primary products may be recovered from the pyrolysis zone by minimizing their residence time and exposure to high temperatures. These primary vapor products condense to form an acidic, water-soluble, reactive oil, which as nearly the same elemental composition as the feedstock. Depending upon the desired application, these primary oils can be used without modification or they may be chemically changed to meet the requirements of a specific application, e.g., storable boiler fuels or high-octane gasoline. The authors newly initiated approach to the upgrading of these oils is to utilize low-pressure processes, which essentially precludes conventional hydrogenation reactions.

446 **Hydrotreating biomass liquids to produce hydrocarbon fuels.** Elliott, D.C.; Baker, E.G. (Pacific Northwest Lab., Richland, WA 99352). pp 765-784 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—). Contract AC06-76RL01830.

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

Experimentation is underway at Pacific Northwest Laboratory to investigate the thermochemical transformation of biomass to liquid hydrocarbon fuels. Recent emphasis has been on the upgrading of the crude oil from biomass to the finished hydrocarbon. Specifically, catalytic hydrotreating of the crude oil is performed to reduce the molecular weight and remove oxygen. Experimentation has involved the use of a continuous-feed, fixed-bed catalytic reactor to hydrodeoxygenate and hydrocrack the biomass crude oils at conditions of 250°C to 400°C and 2000 psig. Catalysts and conditions similar to those used in petroleum hydrotreating have been used to produce a nearly pure hydrocarbon liquid product. The process optimization has emphasized minimizing hydrogen consumption in order to maintain the aromatic character of the product and minimize gas production. Both wood-derived high-pressure liquefaction oils and flash-pyrolysis oils have been used as feedstocks for hydrodeoxygenation. Research results are presented pertaining to a two-step hydrotreating process designed for the pyrolysis oils. In the first step, a low-temperature (270°C) catalytic (sulfided cobalt-molybdenum) treatment is used to process the thermally unstable pyrolyzate into a tar similar in characteristics to the high-pressure liquefaction product. This tar can then be hydrodeoxygenated and hydrocracked by conventional hydrotreating techniques to produce a gasoline.

447 **The influence of copper and pore size on the activity and selectivity of precipitated iron catalysts.** Diehl, J.R.; Stencel, J.M.; Diffenbach, R.A.; Fauth, D.J. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). pp P-17 of The ninth North American meeting of the Catalysis Society. Wilmington, DE; Catalysis Society (of North America) (1985). (CONF-8503251—).

From 9. North American meeting of the Catalysis Society; Houston, TX, USA (17 Mar 1985).

Copper-promoted, precipitated iron F-T synthesis catalysts of varying pore size have been investigated with both surface and bulk analytical techniques and with reactor studies. Surface analyses of the catalysts were performed in both their H/sub 2/ and CO activated states as well as their as-prepared and deactivated states. These analyses were performed to determine the roles of pore size, promoter concentration, and activation procedure on the surface

properties and to provide correlation of these physical and chemical characteristics with the activity and selectivity to form hydrocarbons in the conversion of H/sub 2/ + CO. The XPS and ISS data show that the Na concentration on the surface to be not only dependent on the bulk Na concentration but also to be dependent on the pore size. The pore size in general decreases with increasing pH of the precipitating solution during catalyst preparation. TGA data show evidence of carbon deposition on the catalyst during H/sub 2/ + CO exposure; the amount of carbon deposited depends on the pore size and Na concentration. Concerning the activity and selectivity, the olefin to paraffin ratio is observed to be related directly to the Cu content and the pore size while the activity maintenance of the catalysts during H/sub 2/ + CO conversion is also shown to be related to the pore size and Na content.

448 **Effect of ferric ion clustering on the Fischer-Tropsch catalytic activity of aluminoferrisilicate materials with the ZSM-5 type zeolite structure.** Iton, L.E.; Miranda, R.; Hamot, P.J.; Shenoy, G.K. (Materials Science and Technology Div., Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL 60439). pp P-22 of The ninth North American meeting of the Catalysis Society. Wilmington, DE; Catalysis Society (of North America) (1985). (CONF-8503251—).

From 9. North American meeting of the Catalysis Society; Houston, TX, USA (17 Mar 1985).

Aluminoferrisilicate (AFS) materials have been crystallized with the ZSM-5 and Offretite type crystal structures. Active Fischer-Tropsch catalysts can be obtained when the calcined material is subsequently reduced. In the case of the AFS ZSM-5, the degree of clustering of the Fe/sup 3+/ ions during the calcination step depends on the temperature and the O/sub 2/ partial pressure. The authors have observed that the clustering of the Fe/sup 3+/ ions into superparamagnetic (spm) oxide aggregates causes the Fischer-Tropsch activity of the resulting catalyst to be greatly suppressed.

449 **Aluminoferrisilicate zeolites: Synthesis; characterization; and Fischer-Tropsch catalysis.** Iton, L.E.; Rauscher, D.J.; Miranda, R.; McMahon, K.; Suib, S.L. (Materials Science and Technology Div., Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL 60439). pp P-21 of The ninth North American meeting of the Catalysis Society. Wilmington, DE; Catalysis Society (of North America) (1985). (CONF-8503251—).

From 9. North American meeting of the Catalysis Society; Houston, TX, USA (17 Mar 1985).

Aluminoferrisilicate (AFS) zeolites have been obtained by the incorporation of Fe/sup 3+/ ions during the crystallization of TMA-Offretite (up to 3% Fe) and ZSM-5 (up to 5% Fe) type zeolites. Structural and morphological characterizations have been made using powder XRD, ATR FTIR spectroscopy, and SEM/EDX. After calcination to remove templating molecules, and activation by reduction in H/sub 2/, these zeolites can be active as direct Fischer-Tropsch conversion catalysts. Furthermore, the catalytic activity can be modified by reaction of the AFS zeolite with a transition metal complex anion prior to the activation by H/sub 2/ reduction.

450 **The possible role of hydrogenolysis reactions on the selectivity of metal-zeolite catalysts in synthesis gas conversion.** Rao, V.U.S.; Gormley, R.J.; Schehl, R.R.; Obermyer, R.T.; Chi, R.D.H. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940). pp A-22 of The ninth North American meeting of the Catalysis Society. Wilmington, DE; Catalysis Society (of North America) (1985). (CONF-8503251—).

From 9. North American meeting of the Catalysis Society; Houston, TX, USA (17 Mar 1985).

Certain aspects of selectivity of metal-zeolite catalysts in synthesis gas conversion appear to be connected with secondary reactions on the metal surface. Among cobalt-ZSM-5 catalysts that have been prepared by different methods, there is a correlation between the methane yield and the percent aromatics in the liquid hydrocarbon product. The connection between the selectivities to aromatics and methane can be traced through the formation of additional alkanes (C/sub 3/H/sub 8/ and C/sub 4/H/sub 10/) in the hydrogen transfer reactions accompanying the aromatization process. The alkanes appear to undergo hydrogenolysis over cobalt leading to the formation of additional methane.

451 **Structural speciation and Fischer-Tropsch activity of Fe/Mn catalysts.** Stencel, J.M.; Diehl, J.R.; Miller, S.R.; Pennline, H.W.; Zarochak, M.F. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). pp A-32 of The ninth North American meeting of the Catalysis Society. Wilmington, DE; Catalysis Society (of North America) (1985). (CONF-8503251—).

From 9. North American meeting of the Catalysis Society; Houston, TX, USA (17 Mar 1985).

The FT activity and structural characteristics of a series of coprecipitated Fe/Mn catalysts have been investigated to provide correlations between their selectivity/activity for hydrocarbon synthesis and their surface/bulk speciation. These studies include low-ratio synthesis gas, slurry phase reactor testing of catalysts with compositions in the range 10 Fe/90 Mn to 50 Fe/50 Mn, in addition to reactor testing of 20 Fe/80 Mn catalysts containing K in the range of 0.1 wt.% to 1.5 wt.%. A small amount of these catalysts was extracted from the reactor at various times within the catalytic runs while maintaining reaction conditions. These wax-encapsulated samples were analyzed by bulk and surface-sensitive spectroscopic techniques to enable comparison of their structural/chemical features with those of catalysts that had been activated and analyzed under gas-phase, in-situ techniques. These studies have permitted the identification of factors influencing catalyst activation and deactivation, product selectivity for the production of olefinic hydrocarbons, and the extent of metal-support interactions.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 1659

452 **(DOE/PC/90013—T2) Optimum catalytic process for alcohol fuels from syngas: Second quarterly technical progress report.** (Union Carbide Corp., South Charleston, WV (USA). Engineering, Manufacturing and Technology Services Div.). 30 Jul 1987. Contract AC22-86PC90013. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001565/JAW.

A base case process for economic studies of making fuel alcohols from syngas has been developed. It uses existing technologies which have been demonstrated to be feasible or have already been commercialized. The process consists of the following steps: coal or natural gas (reforming or partial oxidation) to syngas; syngas to methanol by ICI technology; methanol to light olefins by proprietary UCC technology using molecular sieves; olefins to alcohols by hydroformylation (with a homogeneous rhodium catalyst) followed by hydrogenation. Process economics for the two natural gas-based routes have been developed. With insights gained from this, an optimized and integrated multi-step process has been conceptualized which allows estimation of the lowest cost at which fuel alcohols can be produced. A 60% methanol and 40% higher alcohol mix was assumed to be a suitable fuel alcohol blend for gasoline. At a natural gas price of $2/MMBTU, the cost of producing this, by either partial oxidation or reforming, is $1.12/gal. An integrated process with autothermal reforming at 750 psia and methanol synthesis at 700 psia allows incorporation of the best features of reforming and partial oxidation as well as elimination of syngas compression. The production cost of fuel alcohols by this process is estimated to be $0.90/gal. This is, therefore, the lowest cost at which fuel alcohols can be produced by an integrated, multi-step process. An "ideal" process has also been conceptualized which establishes a target production cost that new technology should strive for to be competitive. This process incorporates autothermal reforming for producing syngas followed by conversion to fuel alcohols using emerging technologies. The target production cost is estimated to be $0.65/gal. 16 figs., 10 tabs.

453 (EUR—10070-DE-EN-FR, pp 142-158) **Synthesis gas conversion to alcohols.** Richards, D.G. (National Coal Board, Cheltenham, UK. Coal Research Establishment). 1985. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8412110—1).

From Round table meeting on chemical and physical valorization of coal; Brussels, Belgium (7 Dec 1984).

Technical coal research.

Studies have been carried out to develop catalysts selective for the formation of higher alcohols (ethanol and propanol) from synthesis gas. Rhodium and rhodium-cobalt catalysts were tested at 200/sup 0/C with synthesis gas (H/sub 2/:CO = 2:1 v/v), at 100 bar pressure and gaseous hourly space velocities of 1000-1200 h/sup -1/, in a bench-scale 15 ml fixed-bed reactor. Catalyst supports were found to have a strong influence on the selectivities, such that, by correct choice of the support and active metal, higher alcohol selectivities could be maximised. Temperature-programmed reduction was used to investigate the reducibility of oxidised catalysts and the nature of the interaction between the support and the catalytic metal. Oxygenate selectivities for rhodium catalysts increased from ≃ 50% to 100% when calcium aluminate cement was added to titania supports; however, methanol was the major product. Temperature-programmed reduction profiles showed that high selectivities may be related to increased stability of a rhodium oxide phase under test conditions. Incorporation of cobalt into these catalysts reduced the total oxygenate selectivity, although higher alcohol selectivities were increased to a maximum of 26%. Such values were not maintained after 3 hours on stream. This suggests that the active species for oxygenate formation is an oxidised state of rhodium formed by reaction with water.

454 **Glycolytic flux in Zymomonas mobilis: enzyme and metabolite levels during batch fermentation.** Osman, Y.A.; Conway, T.; Bonetti, S.J.; Ingram, L.O. (Univ. of Florida, Gainesville). *Journal of Bacteriology;* **169**: No. 8, 3726-3736(Aug 1987).

The rate at which Z. mobilis (Entner-Doudoroff pathway) converts high concentrations of glucose (20%) into ethanol plus CO_2 changes as ethanol accumulates in the surrounding broth. This decline in glycolytic activity (per milligram of cell protein) does not result from inhibitory effects of ethanol, which can be reversed immediately by ethanol removal. The peak of fermentative activity (58 μmol of CO_2 evolved per mg of cell protein per h) occurred after the accumulation of 1.1% ethanol (18 h) and declined to one-half this rate after 30 h (6.2% accumulated ethanol), although the cell number continued to increase. These times corresponded to the end of exponential growth and to the onset of the stationary phase (on the basis of measurement of cell protein), respectively. An examination of many of the requirements for fermentation revealed three possible reasons for this early decline in activity: decreased abundance of nucleotides, a decrease in internal pH from 6.3 to 5.3, and a decrease in the specific activities of two glycolytic enzymes (pyruvate kinase and glyceraldehyde-3-phosphate dehydrogenase).

455 **Fermentation of lignocellulosic feedstocks: Product markets and values.** Gaines, L.L.; Karpuk, M. (Energy and Environmental Systems Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). pp 1395-1416 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—). Contract W-31-109-ENG-38.

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

Ethanol is the primary product of biomass hydrolysis and fermentation processes. The quantity and quality of coproducts depend on the feedstock and on the process steps employed. When the feedstock is lignocellulosic - wood or herbaceous energy crops, such a napier grass or kenaf - substantial quantities of lignin and five-carbon sugars and derivatives are produced, and the sale of these and other coproducts has a potentially large impact on the economics of fuel alcohol production. For each product, potential markets and materials competing for these markets (or competing routes to the same product) are identified. The value of ethanol as a chemical, octane enhancer, and fuel is estimated. Coproduct credits are calculated, and the potential benefits resulting from coproduct recovery are estimated. The quantity of each material that could be produced by fermentation is compared with the size of potential markets. Where coproducts of substantial fuel ethanol manufacture could saturate their markets, the question of whether early sales could serve as a wedge to ethanol market penetration is addressed.

456 **Comparative technical evaluation of acid hydrolysis processes for conversion of cellulose to alcohol.** Wright, J.D.; Power, A.J. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 949-972 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

This paper evaluates five major acid hydrolysis processes for the conversion of lignocellulosic feedstocks to ethanol. A complete conversion process was defined, and alternative hydrolysis processes integrated into this framework. Differences in ethanol price are directly related to the performance characteristics of the hydrolysis process. The sensitivity of the process economics to technical improvements was also evaluated.

457 **Conversion of wood to aromatic gasoline with zeolite catalysts.** Diebold, J.P.; Scahill, J.W. New York, NY; American Institute of Chemical Engineers (1987). 19p. (CONF-870323—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers spring national meeting; Houston, TX, USA (29 Mar 1987).

Technical Paper 39A.

The conversion of wood to gasoline is discussed via fast pyrolysis to oxygenated vapors followed by catalytic conversion with ZSM-5 of those vapors to gasoline at atmospheric pressure and without added hydrogen. The effect of by-product distribution on the potential yield is discussed. Liquid products from a soft-wood feedstock are compared to those from methanol under similar conditions. The gasoline product is very heavily dominated by methylated benzenes and is expected to have a very high blending octane. A process flow diagram is presented.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 521, 522, 1119, 1122, 1131

458 (ANL/CNSV-TM—173, pp 40-46) **Refuse-derived fuels: research and on-line results.** Daugherty, K.E.; Venables, B.J.; Ohlsson, O.O. (North Texas State Univ., Denton). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

This project is aimed at the production of environmentally acceptable, chemically/biologically stable, and storable densified-Refuse Derived Fuel (d-RDF) pellets which are similar to lignite coal. In order to accomplish this, a suitable binder(s) must be used. Over 100 binders were investigated by a laboratory screening procedure. Six binding materials were selected for pilot plant/commercial scale studies. Approximately seven tons of RDF from Ames, Iowa and Refcom, Pompano Beach, Florida were pelletized in the summer-1985 in a series of experiments at the Jacksonville, Florida, Naval Air Station using these binders. The pelletized d-RDF was then subjected to a battery of chemical and physical tests. Results to date will be discussed.

459 **Pretreatment of woody biomass for low-pollution combustion.** Ramohalli, K.N.R.; Miller, C.A.; Palmer, J.S. (Aerospace and Mechanical Engineering Dept., Univ. of Arizona, Tucson, AZ 85721). pp 427-454 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

The concept of simple, inexpensive pretreatment for low-pollution combustion of woody biomass is explored in a multi-phase program. Based on the belief that a good theoretical understanding of the fundamentals is necessary for an economical program, the

micro-details of wood pyrolysis are investigated. The fibrous heterogeneity and the nonlinear Arrhenius degradation term are explicitly included. Analytical solutions are obtained through the method of matched asymptotic expansion; only the final solutions are quoted in this paper. Guided by the theory, small-scale (1" diameter x 2" long) are burned in a furnace. The samples are instrumented with fine bead (52 μ) thermocouples. Morphological structural changes are carefully observed through scanning electron microscopy. Based on earlier successes with graphite/carbon and coal, a 0.5% solution of calcium acetate is used to pretreat the wood, and the experiments are repeated. Time to ignition and the temperature profiles are obtained. The differences in the char, ash, and residue are noted and compared with the pretreatment case. The differences seem to indicate promise for the promotion of widespread use of woody biomass as an energy source. Bench scale furnace designs are prepared (for kg/hr of wood burning), and a detailed cost/benefit analysis is performed.

460 **Industrial wood fuel market assessment in Washington State.** Kerstetter, J.D. (Washington State Energy Office, Olympia, WA 98504). pp 1323-1338 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

Manufacturing industries in Washington State have the potential for using wood fuels to help meet their energy needs. The author reviewed the use of purchased fuels in Washington's industrial sector and established criteria to identify potential wood fuel users. They targeted large fuel purchasers with steam and hot water as their primary energy uses and reduced the population of 6,000 facilities down to a target group of 300. The 300 facilities were surveyed to determine what criteria they use for making capital investment decisions and what their knowledge and interest was in using wood fuel. The authors determined that the principal barrier that must be surmounted is economic. They also learned that 45 percent of the firms that have not investigated the use of wood fuels were not even aware of its potential.

13 HYDRO ENERGY

1301 Resources And Availability

REFER ALSO TO CITATION(S) 1838

1302 Site Geology And Meteorology

461 **(NP—7770294) Calculation of pressure tunnels. Development and use of a mathematical model and determination of rock mechanic parameters.** Schwarz, J. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wassermengenwirtschaft; Technische Univ. Muenchen, Obernach (Germany, F.R.). Versuchsanstalt fuer Wasserbau). 1987. 187p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87770294/JAW.

The mathematical equations of stress analysis of pressure tunnels in hydroelectric power plants can be reduced so that an analytical solution becomes possible. This results in a new program system, its application and advantages are shown by some examples. The second problem in rock mechanics is the scattering of the parameters. The most important and sensitive parameters are found by comparative calculations and then described by stochastical models. Coupling these models with the new program system results in a method to calculate the security of a pressure tunnel. The last chapter deals with the possibilities of measuring the rock mechanical parameters for the model.

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 461

1304 Regulations And Licensing

REFER ALSO TO CITATION(S) 1008

1305 Economics And Management

REFER ALSO TO CITATION(S) 1004

462 **(DOE/BP—827, pp 47-63) Evolving Pacific Coast Energy System Panel.** Apr 1987. NTIS, PC A06/MF A01. Order Number DE87009112/JAW.

In Third annual Bonneville Power Administration/State of Washington informational meeting: Vance Tyee Motor Inn, Tumwater, Washington, October 22, 1986.

A panel discussion on the nature of and issues associated with the Northwest power distribution system involved representatives of Northwest power utilities who described how the system works to bring several entities into a shared responsibility arrangement that will ensure adequate and available energy supplies. Some described the arrangements between the Northwest utilities and California, Canada, and other markets in terms of buyers, sellers, and structure. Their discussions examined both short- and long-term planning, as well as strategies for meeting challenges and developing new opportunities. Questions and answers relating to the presentations follows the formal statements of the three panelists.

463 **(DOE/BP—827, pp 64-88) Shaping the Pacific Coast Energy Agenda Panel.** Apr 1987. NTIS, PC A06/MF A01. Order Number DE87009112/JAW.

In Third annual Bonneville Power Administration/State of Washington informational meeting: Vance Tyee Motor Inn, Tumwater, Washington, October 22, 1986.

The third panel of the meeting included representatives of state energy and utility commissions, municipal utilities, and the Northwest Power Planning Council examined the interrelations between power planning decisions and future energy supplies and prices. Speakers addressed institutional constraints, the roles of state and regional power commissions, and the need for cooperation within the regulatory community because of the political and economic impact that power decisions have. Deregulation of the electric power industry, competition among energy marketers, and antitrust laws were among the points raised. The focus was on emerging technological and regulatory opportunities. Questions asked of the panelists and their responses follow the formal presentations.

464 **(OH/LF/PSPB—861208) Load forecast.** (Ontario Hydro, Toronto (Canada). Load Forecasts Dept.). Mar 1987. 93p. (MICROLOG—87-02398). Ontario Hydro, Economics and Forecasts Division, 700 University Avenue, Toronto, Ontario, Canada M5G 1X6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

The Load Forecasts Department of the Economics and Forecasts Division of Ontario Hydro issues two load forecasts each year: a Long-Term Forecast produced in the fall for system planning purposes, with emphasis on total system demand and a time horizon of approximately 20 years, and a Short-Term Forecast produced early summer for revenue planning, rate development and budget purposes. This Load Forecast Report 861208 contains the two forecast produced and approved in the calendar year 1986: the Short-Term Load Forecast approved by the Board of Directors on December 8, 1986, and the Long-Term Forecast approved by the Board of Directors on December 8, 1986. The Short-Term Load Forecast (1986-1991) is prepared by using the results of a customer survey carried out in the spring called Regional Estimates, economic forecasts based on the latest trends and anticipated changes in the economic environment, electricity demand forecast models relying on the most recent data, analysis of the deviations of recent Ontario electricity demands from last year's predictions and forecast of In-

direct Incentives. The Long-Term Load Forecast (1992-2005) was obtained through the integration of the following factors: short-term results, long-term economic outlook, econometric model EDEM results, end-use model results, 1985 Load Forecast, judgemental factors, and Indirect Incentives. 22 tabs.

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 1840

14 SOLAR ENERGY

1401 Resources And Availability

REFER ALSO TO CITATION(S) 568

465 **Empirical radiometric correction of a silicon photodiode rotating shadowband pyranometer.** Michalsky, J.J.; Harrison, L.; LeBaron, B.A. (Pacific Northwest Lab., Richland, WA). *Solar Energy;* **39**: No. 2, 87-96(1987). Contract AC06-76RL01830.

The authors have improved the silicon photodiode-based rotating shadowband pyranometer[1] to suit it for radiometric observations by deriving empirical corrections to mimic thermopile sensors. The authors present the results of an intercomparison between their rotating shadowband pyranometer and a conventional complement of first-class thermopile instruments. The daily integrated values for total horizontal, diffuse horizontal and direct normal irradiance measured with their rotating shadowband radiometer agree on average to better than 1%, 3%, and 2.5%, respectively, with the thermopile results, after their empirically derived corrections are applied. In absolute units, 10-minute integrated values seldom differ by more than 20 watts/m^2 from thermopile values.

1403 Economics

REFER ALSO TO CITATION(S) 455, 460, 540, 1010

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 524

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 433, 438, 440, 441, 442, 443, 444, 445, 446, 454, 455, 456, 457, 459, 460, 566, 1011, 1024, 1107, 1292, 1296, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1912

466 **(AD-A—183374/8/XAB) Temperance dependence of shunt resistance in photovoltaic devices. Technical report.** Banderjee, S.; Anderson, W.A. (State Univ. of New York, Buffalo (USA). Dept. of Electrical Engineering). 7 Jul 1987. 6p. (TR—5). NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 49, No. 1, 38-40(7 Jul 1986).

Shunt resistance in surface-passivated Si solar cells was experimentally shown to be temperature-dependent with a maximum value of $2x10^7$ ohms/sq. cm. Mechanisms responsible for shunt resistance are identified as a combination of multistep tunneling and thermal trapping-detrapping of carriers through the defect states in the space-charge region.

467 **(AD-A—183378/9/XAB) Electron irradiation effects on the shunt resistance of silicon solar cells. Technical report, 1 August 1986-31 July 1987.** Banderjee, S.; Anderson, W.A. (State Univ. of New York, Buffalo (USA). Dept. of Electrical Engineering). 31 Jul 1987. 10p. (TR—6). NTIS, PC A02/MF A01.

Shunt resistance Rsh values greater than 5 X 10^6 ohms were measured for high-efficiency silicon solar cells fabircated by a low temperature diffusion technique, whereas lower values ((0.5-.0)x100,000 ohms) were obtained for ion-implanted solar cells. A degradation in Rsh values by an order of magnitude was observed after electron irradiations of 1 MeV to a fluence of 1 X $10th^{16}$ e^- per sq. cm. Temperature-dependence studies indicated a rapid decrease in Rsh above a threshold temperature which is sensitive to the device quality. As the fluence of irradiation increased, very little shift in the threshold temperature towards lower values was observed. The degradation in Rsh causes an enhancement in the dark-saturation current which is partly responsible for degradation in the open-circuit voltage of the devices.

468 **(AFME—82-093) Looking for and study of amylolitic yeasts for alcohol production from amylaceous substrates.** Moulin, G.; Galzy, P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 106p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750282/JAW.

The aim of this study was to determine the best phyllum for the direct fermentation of soluble starch; Endomycopsis fibuligera, Schwanniomyces castellii and Schwanniomyces alluvius have been tested and the ethanol production and starch degradation were measured, as a function of the glucose and starch contents. Schwanniomyces castellii have the best potential characteristics.

469 **(AFME—83-210) Economy.** Sourie, J.C. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 61p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750278/JAW.

This review is composed of four main topics related to the economic analysis in the french agricultural energy consumption: analysis of the energy consumption in agriculture and effects of the energy crisis on the french agriculture, evaluation of the agricultural biomass supply for energy purposes and analysis of the competition between the various uses of the resource, economic evaluation of the different energy conversion ways, and comparison of the biomass-energy supply and demand on a district level evaluation (in France).

470 **(AFME—83-210-5) Forest Biomass.** Teissier du Cros, E. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 50p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750279/JAW.

Research and development in forest biomass production in France are reported, especially coppice cultivation. In a first section, the amelioration of the existing coppices is evaluated: estimation of the resource, evaluation of the effect of the coppice cultivation on the ecosystem, study of the root system and functionment, and setting of forestry growth technics for natural coppices. In the second section, the potential artificial coppice resource is analyzed: research for new genotypes, setting of specially adapted forestry techniques and study of the soil variability.

471 **(BMFT-FB-T—86-203) Gasification of biomass for electric power generation. Final report.** Kloeckner, P.; Rauchfuss, H.; Craemer, U. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); KHD Humboldt Wedag A.G., Koeln (Germany, F.R.); Kloeckner-Humboldt-Deutz A.G., Koeln (Germany, F.R.)). Dec 1986. 82p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753252/JAW.

The most important aspect of this R+D-project was the improvement of the environmental protection. This arrangement included: the hot gas dedusting by a multiple tube filter as well as the avoidance of the formation of condensate when cooling the producer gas before entering the gas engine. The hot gas dedusting by a ceramic multiple tube filter indicated some mechanical problems which prevented the faultless function of the filter. Also the avoidance of the condensate formation respectively its removal was more difficult than originally supposed. Further difficulties for the gasifiers in the Federal Republic of Germany and also for the pilot plant at Cologne arised because - contrary to a former information of the responsible authorities - since 1985 all gasifiers are subjected to authorization and therefore they are subjected to the hard duties of the TA-Luft (Clean Air Technical Guide). Because of the additional arrangements and installations the investment and operating costs

arise to such a degree that the economy of the process is not more guaranteed. By this reason the above mentioned R+D-project was stopped precociously. With 13 refs., 23 figs.

472 **(CONF-870528—21) Measured performance of ENTECH's crossed lens photovoltaic concentrator.** McDanal, A.J. (Entech, Inc., Dallas-Fort Worth Airport, TX (USA)). May 1987. Contract AC05-84ER80126. 6p. NTIS, PC A02. Order Number DE88000622/JAW.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Over the past several years, ENTECH has been developing a patented, optical concentrator concept called the crossed lens concentrator. Detailed design studies and analytical performance analyses conducted on this optical concept have resulted in the development of two types of photovoltaic concentrator modules: a 160X crossed lens module which uses advanced silicon cells and a 500X crossed lens module which uses gallium arsenide (GaAs) cells. An innovative prismatic cell cover has been developed which completely eliminates gridline obscuration losses on the photovoltaic cell. A cell cover has been fabricated and tested which will allow 55% of the cell's active area to be obscured by gridlines. Designs for the 160X silicon cell and the 500X GaAs cell have been generated and are currently being fabricated by Solarex and ASEC, respectively, for use with the new cell cover. Both module designs are described and recent test results are presented. 4 refs.

473 **(DOE/CE/15270—T3) Explorations of mechanisms regulating ectomycorrhizal colonization of boron-fertilized pine: Quarterly report, July 1, 1987-September 30, 1987.** Garrett, H.E.; Reid, R.K.; Sword, M.A. (Missouri Univ., Columbia (USA). School of Forestry, Fisheries and Wildlife). 1987. Contract FG01-86CE15270. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000146/JAW.

This report describes three months research on fungal colonization of pine roots. Each of three research paths is subdivided into multiple tasks; progress in experimental design as well as current status are discussed for each task. 16 refs. (TEM)

474 **(FRNC-R—138) Energetic use of cereal straw: economic analysis of processes and of choice between various utilizations.** Requillart, A. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 334p. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750281/JAW.

The first part of this study is concerned with the energy consumption of a farm and its position in front of the energy crisis. The energy from the straw is an important alternative energy resource. Its potential supply in France is then analyzed together with a micro economical survey of its different utilizations (combustion, chemical treatment) and applications (space heating, corn drying, greenhouse heating, animal feeding). A macro economical impact study is then proposed.

475 **(FRNC-TH—3034) Study of potential profiles and doping of amorphous hydrogenated silicon by in-situ use of a Kelvin probe.** Siefert, J.M. (Paris-11 Univ., 91 - Orsay (France)). Jun 1986. 220p. (In French). NTIS (US Sales Only), PC A10. Order Number DE88750274/JAW.

This thesis shows how in situ surface potential measurements by means of a Kelvin probe, combined with the plasma deposition of hydrogenated amorphous silicon (a-Si:H) thin films, allow a determination of the Fermi level position as a function of doping and of the potential profiles at a-Si:H based junctions. The densities of bulk and surface localized states are deduced for large phosphorus and boron doping ranges. The density of deep bulk states is about 5x10/sup 16/ cm/sup -3/ in undoped samples, and it increases with doping. A low value cf the density of surface states is found, about 5x10/sup 11/ cm/sup -2/ eV/sup -1/, independent of doping. This value increases, due to surface treatments (oxidation, argon plasma). Spectroscopic photovoltages are also studied, particularly in situ. It is shown that space charge layers and photons penetration depths are essential elements for their understanding.

476 **(IFU-B—12-85) Development of a manure/manure heat exchanger. Test of the prototype. Pt. A and B. Pt. A: Pit heat exchanger. Pt. B: Pipe heat exchanger. Final report.** Padinger, R.; Spitzer, J.; Brunner, N.; Karrer, M.; Schuetz, P. (Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung). Apr 1985. 103p. (In German). Forschungszentrum Graz, Austria, Inst. fuer Umweltforschung.

In agricultural biogas plants organic material (manure) is decomposed in a fermentation process to low-molecular compounds, thereby producing combustible biogas. One part of the biogas energy is used for heating the manure up to a temperature necessary for the fermentation process. The heat contained in the fermented manure can be used for heating up the fresh manure in a manure/manure heat exchanger. Subject of the project was the construction and test of a 'pit heat exchanger' and a 'pipe heat exchanger' and the examination of their efficiency. For the 'pit heat exchanger' an evaluation of its economy was made. With 45 figs., 20 tabs.

477 **(LBL—23453) Proceedings of the eleventh DOE solar photochemistry research conference.** (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 202p. (CONF-870666—Summs.). NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88000678/JAW.

From 11. DOE solar photochemistry research conference; Tahoe City, CA, USA (7 Jun 1987).

In this volume may be found the program of the Eleventh DOE Solar Photochemistry Research Conference, the abstracts of 28 formal presentations and 42 posters, a record of the often lively questions and answers following each presentation, and a list of the 93 attendees.

478 **(N—87-25480) Evaluation of candidate oxidation resistant materials for space applications in LEO.** Rutledge, S.; Banks, B.; Difilippo, F.; Brady, J.; Dever, T.; Hotes, D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. 16p. (NASA-TM—100122; E—3669; NAS—1.15:100122; CONF-8611131—3). NTIS, PC A02/MF A01.

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

Ground based testing of materials considered for polyimide (Kapton) solar array blanket protection and graphite-epoxy structural member protection was performed in an RF plasma asher. Protective coatings on Kapton from various commercial sources and from NASA Lewis Research Center were exposed to the air plasma; and mass loss per unit area was measured for each sample. All samples evaluated provided some protection to the underlying surface, but metal-oxide-fluoropolymer coatings provided the best protection by exhibiting very little degradation after 47 hr of asher exposure. Mica paint was evaluated as a protective coating for graphite-epoxy structural members. Mica appeared to be resistant to attack by atomic oxygen, but only offered limited protection as a paint. this is believed to be due to the paint vehicle ashing underneath the mica leaving unattached mica flakes lying on the surface. The protective coatings on Kapton evaluated so far are promising but further research on protection of graphite-epoxy support structures is needed.

479 **(N—87-26141) Recent developments in indium phosphide space solar cell research.** Brinker, D.J.; Weinberg, I. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1987. 13p. (NASA-TM—100139; E—3690; NAS—1.15:100139; AIAA—87-9053; CONF-870804—44). NTIS, PC A02/MF A01.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Recent developments and progress in indium phosphide solar cell research for space application are reviewed. Indium phosphide homojunction cells were fabricated in both the n+p and p+n configurations with total area efficiencies of 17.9 and 15.9% (air mass 0 and 25 C) respectively. Organometallic chemical vapor deposition, liquid phase epitaxy, ion implantation and diffusion techniques were employed in InP cell fabrication. A theoretical model of a radiation tolerant, high efficiency homojunction cell was developed. A realis-

tically attainable AMO efficiency of 20.5% was calculated using this model with emitter and base doping of 6 x 10 to the 17th power and 5 x 10 the the 16th power/cu cm respectively. Cells of both configurations were irradiated with 1 MeV electrons and 37 MeV protons. For both proton and electron irradiation, the n+p cells are more radiation resistant at higher fluences than the p+n cells. The first flight module of four InP cells was assembled for the Living Plume Shield III satellite.

480 (N—87-26173, pp vp) **Evaluation of candidate oxidation resistant materials.** Rutledge, S.; Banks, B.; Mirtich, M.; Difilippo, F.; Hotes, D.; Labed, R.; Dever, T.; Kussmaul, M. (Cleveland State Univ., OH). Jun 1987. NTIS, PC A09/MF A01. (NASA-CR—181163; JPL—87-14; NAS—1.26:181163; CONF-8611131—).

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

Ground based testing of materials considered for Kapton solar array blanket protection, graphite epoxy structural member protection, and high temperature radiators was performed in an RF plasma asher. Ashing rates for Kapton were correlated with rates measured on STS-8 to determine the exposure time equivalent to one year in low Earth orbit (LEO) at a constant density space station orbital flux. Protective coatings on Kapton from Tekmat, Andus Corporation, and LeRC were evaluated in the plasma asher and mass loss rates per unit area were measured for each sample. All samples evaluated provided some protection to the underlying surface but ion beam sputter deposited samples of SiO_2 and SiO_2 with 8% polytetrafluoroethylene (PTFE) showed no evidence of degradation after 47 hours of exposure. Mica paint was evaluated as a protective coating for graphite epoxy structural members. Mica appears to be resistant to attack by atomic oxygen but only offers some limited protection as a paint because the paint vehicles evaluated to date were not resistant to atomic oxygen. Four materials were selected for evaluation as candidate radiator materials: stainless steel, copper, niobium-1% zirconium, and titanium-6% aluminum-4% vanadium. These materials were surface textured by various means to improve their emittance. Emittances as high as 0.93 at 2.5 microns for stainless steel and 0.89 at 2.5 microns for Nb-1 Zr were obtained from surface texturing. There were no significant changes in emittance after asher exposure.

481 (N—87-26413) **Space photovoltaic research and technology 1986. High efficiency, space environment, and array technology.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1987. 375p. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—). NTIS, PC A16/MF A01.

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

The conference provided a forum to assess the progress made, the problems remaining, and the strategy for the future of photovoltaic research. Cell research and technology, space environmental effects, array technology and applications were discussed.

482 (N—87-26413, pp vp) **Overview of photovoltaic applications in space.** Wasel, R.A. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

An overview is given of the uses of photovoltaic (PV) power in space. The contribution of PV systems on unmanned, low Earth orbit and inner planetary missions is noted. The development of PV technology along the two paths of high efficiency and high power is discussed. The importance of increasing the service life of PV systems is covered.

483 (N—87-26413, pp vp) **Point contact silicon solar cells.** Swanson, R.M. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

A new type of silicon solar cell has been developed. It is called the point-contact cell because the metal semiconductor contacts are restricted to an array of small points on the back of the cell. The point contact cell has recently demonstrated 22 percent conversion efficiency at one sun and 27.5 percent at 100 suns under an AM1.5 spectrum.

484 (N—87-26413, pp vp) **High-efficiency GaAs concentrator space cells.** Werthen, J.G.; Virshup, G.F.; Macmillan, H.F.; Ford, C.W.; Hamaker, H.C. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

High efficiency Al/sub x/ Ga/sub 1-x/As/GaAs heteroface solar concentrator cells have been developed for space applications. The cells, which were grown using metalorganic chemical vapor deposition (MOCVD), have been fabricated in both the p-n and n-p configurations. Magnesium and zinc are used as the p-type dopants, and Se is used as the n-type dopant. The space cells, which are designed for use in a Cassegrainian concentrator operating at 100 suns, AMO, have a circular illuminated area 4 mm in diameter on a 5 mm by 5 mm cell. These cells have exhibited flash-tested efficiencies as high as 23.6 percent at 28 C and 21.6 percent at 80 C.

485 (N—87-26413, pp vp) **Thermal stress cycling of GaAs solar cells.** Francis, R.W. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

Thermal stress cycling was performed on gallium arsenide solar cells to investigate their electrical, mechanical, and structural integrity. Cells were cycled under low Earth orbit (LEO) simulated temperature conditions in vacuum. Cell evaluations consisted of power output values, spectral response, optical microscopy and ion microprobe mass analysis, and depth profiles on both front surface inter-grid areas and metallization contact grid lines. Cells were examined for degradation after 500, 5000, 10,000 and 15,245 thermal cycles. No indication of performance degradation was found for any vendor's cell lot.

486 (N—87-26413, pp vp) **Heterostructure solar cells.** Chang, K.I.; Yeh, Y.C.M.; Iles, P.A.; Morris, R.K. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

The performance of gallium arsenide solar cells grown on Ge substrates is discussed. In some cases the substrate was thinned to reduce overall cell weight with good ruggedness. The conversion efficiency of 2 by 2 cm cells under AMO reached 17.1 percent with a cell thickness of 6 mils. The work described forms the basis for future cascade cell structures, where similar interconnecting problems between the top cell and the bottom cell must be solved. Applications of the GaAs/Ge solar cell in space and the expected payoffs are discussed.

487 (N—87-26413, pp vp) **Mechanically-stacked tandem solar cells with GaAsP on GaP and silicon.** Negley, G.H.; Mcneely, J.B.; Lasswell, P.G.; Gartley, E.A.; Barnett, A.M. (Delaware Univ., Newark). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

Preliminary results are encouraging for the achievement of high conversion efficiencies using a GaAsP top solar cell mechanically stacked on a conventional silicon solar cell. A realistic maximum of 29.4 percent is suggested when both the top and bottom solar cells are state of the art. Practical system efficiencies greater than 25 percent are attainable in the near future with the use of a state of the art bottom solar cell.

488 (N—87-26413, pp vp) **Superstructure high efficiency photovoltaics.** Wagner, M.; So, L.C.; Leburton, J.P. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

A novel class of photovoltaic cascade structures is introduced which features multijunction upper subcells. These superstructure high efficiency photovoltaics (SHEP's) exhibit enhanced upper subcell spectral response because of the additional junctions which serve to reduce bulk recombination losses by decreasing the mean collection distance for photogenerated minority carriers. Two possible electrical configurations were studied and compared: a three-terminal scheme that allows both subcells to be operated at their individual maximum power points and a two-terminal configuration with an intercell ohmic contact for series interconnection. The three-terminal devices were found to be superior both in terms of beginning-of-life expectancy and radiation tolerance. Realistic simulations of three-terminal AlGaAs/GaAs SHEP's show that one sun AMO efficiencies in excess of 26 percent are possible.

489 (N—87-26413, pp vp) **Design considerations for a GaAs nipi doping superlattice solar cell.** Clark, R.; Goradia, C.; Brinker, D. (Cleveland State Univ., OH). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

A new GaAs nipi doping superlattice solar cell structure is presented, which holds promise for high efficiency coupled with very high radiation tolerance. The structure has all contacts on the unilluminated side. Design constraints are presented which this structure must satisfy in order to exhibit high efficiency and high radiation tolerance. The results of self-consistent quantum mechanical calculations are presented which show that a viable design of this cell would include relatively thick n and p layers which are fairly heavily doped.

490 (N—87-26413, pp vp) **Processing and characterization of high-efficiency.** Crotty, G.T. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

Silicon solar cells with efficiencies ranging from 17 to 17.7 percent are described. These cells were processed on low-resistivity FZ substrates using techniques recently developed for high efficiency terrestrial solar cells. Preliminary results indicate that the high efficiency cell is more susceptible to radiation damage in that it retains a smaller proportion of its original power output when compared to conventional space cells after exposure to 5 times 10 to the 14th power 1 MeV electrons. However, the cell does maintain a greater overall power output than the conventional cells to which it was compared. Furthermore, this cell does not demonstrate post-electron irradiation photon decay as has been described for cells processed on 1-10 ohm-cm float zone silicon.

491 (N—87-26413, pp vp) **Design study of large area 8 cm x 8 cm wrapthrough cells for space station.** Garlick, G.F.J.; Lillington, D.R. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

The design of large area silicon solar cells for the projected NASA space station is discussed. It is based on the NASA specification for the cells which calls for an 8 cm by 8 cm cell of wrapthrough type with gridded back contacts. The beginning of life (BOL) power must be 1.039 watts per cell or larger and maximum end of life (EOL) after 10 years in the prescribed orbit under an equivalent 1MeV electron radiation damage fluence of 5 times 10 to the 13th power e/square cm. On orbit efficiency is to be optimized by a low thermal absorptance goal (thermal alpha) of .63.

492 (N—87-26413, pp vp) **Ultralight amorphous silicon alloy photovoltaic modules for space applications.** Hanak, J.J.; Chen, E.; Fulton, C.; Myatt, A.; Woodyard, J.R. (Wayne State Univ., Detroit, MI). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

Ultralight and ultrathin, flexible, rollup monolithic PV modules have been developed consisting of multijunction, amorphous silicon alloys for either terrestrial or aerospace applications. The rate of progress in increasing conversion efficiency of stable multijunction and multigap PV cells indicates that arrays of these modules can be available for NASA's high power systems in the 1990's. Because of the extremely light module weight and the highly automated process of manufacture, the monolithic a-Si alloy arrays are expected to be strongly competitive with other systems for use in NASA's space station or in other large aerospace applications.

493 (N—87-26413, pp vp) **Air Force concentrating photovoltaic array program.** Geis, J.W. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

A summary is given of Air Force solar concentrator projects beginning with the Rockwell International study program in 1977. The Satellite Materials Hardening Programs (SMATH) explored and developed techniques for hardening planar solar cell array power systems to the combined nuclear and laser radiation threat environments. A portion of program dollars was devoted to developing a preliminary design for a hardened solar concentrator. The results of the Survivable Concentrating Photovoltaic Array (SCOPA) program, and the design, fabrication and flight qualification of a hardened concentrator panel are discussed.

494 (N—87-26413, pp vp) **Development of a Fresnel lens concentrator for space application.** Oneill, M.J.; Piszczor, M.F. (ENTECH Corp., Dallas-Fort Worth Airport, TX). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

The selected conceptual design of the dome lens photovoltaic concentrator for space applications uses a 3.7 cm square aperture dome lens to focus onto a 0.4 cm active diameter gallium arsenide cell. The selected configuration will provide 91.5 percent lens optical efficiency and 21.4 percent cell efficiency at 100 suns irradiance and 100 C cell temperature, for an overall cell efficiency of 19.6 percent. The selected configuration will tolerate 1 degree tracking errors with negligible loss of performance. The selected panel weight is 2.5 kg/sq.m.

495 (N—87-26413, pp vp) **Photovoltaic conversion of laser power to electrical power.** Walker, G.H.; Heinbockel, J.H. (Old Dominion Univ., Norfolk, VA). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

Photovoltaic laser to electric converters are attractive for use with a space-based laser power station. The results of modeling studies for a silicon vertical junction converter used with a Nd laser are given. A computer code was developed for the model and this code was used to conduct a parametric study for a Si vertical junction converter consisting of one p-n junction irradiated with a Nd laser. These calculations predict an efficiency over 50 percent for an optimized converter.

496 (N—87-26413, pp vp) **Advanced photovoltaic solar array design assessment.** Stella, P.; Scott-Monck, J. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

The Advanced Photovoltaic Solar Array (APSA) program seeks to bring to flight readiness a solar array that effectively doubles the specific power of the Solar Array Flight Experiment/Solar Electric Propulsion (SAFE/SEP) design that was successfully demonstrated during the Shuttle 41-D mission. APSA is a critical intermediate milestone in the effort to demonstrate solar array technologies capable of 300 W/kg and 300 W/square m at beginning of life (BOL). It is not unreasonable to anticipate the development of solar array designs capable of 300 W/kg at BOL for operational power levels approx. greater than 25 kW/sub e/. It is also quite reasonable to expect that high performance solar arrays capable of providing at least 200 W/kg at end of life for most orbits now being considered by mission planners will be realized in the next decade.

497 (N—87-26413, pp vp) **Effect of internal stresses on solar cell efficiency.** Weizer, V.G. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

Diffusion induced stresses in silicon are shown to result in large localized changes in the minority carrier mobility which in turn have a significant effect on cell output. Evidence is given that both compressive and tensile stresses can be generated in either the emitter or the base region. Tensile stresses appear to be much more effective in altering cell performance. While most stress related effects appear to degrade cell efficiency, this is not always the case. Evidence is presented showing that arsenic induced stresses can result in emitter characteristics comparable to those found in the MINP cell without requiring a high degree of surface passivation.

498 (N—87-26413, pp vp) **Recombination imaging of III-V solar cells.** Virshup, G.F. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

An imaging technique based on the radiative recombination of minority carriers in forward-biased solar cells has been developed for characterization of III-V solar cells. When used in mapping whole wafers, it has helped identify three independent loss mechanisms (broken grid lines, shorting defects, and direct-to-indirect bandgap transitions), all of which resulted in lower efficiencies. The imaging has also led to improvements in processing techniques to reduce the occurrence of broken gridlines as well as surface defects. The ability to visualize current mechanisms in solar cells is an intuitive tool which is powerful in its simplicity.

499 (N—87-26413, pp vp) **Light emission as a solar cell analysis technique.** Honsberg, C.; Barnett, A.M. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

In order to determine if a solar cell would indeed emit usable light as expected, a gallium arsenide solar cell was forward biased and examined with an infrared viewer. The light emitted from the solar cell was not uniform, ever though the I-V curve of the solar cell displayed no defects.

500 (N—87-26413, pp vp) **Electro-optical characterization of GaAs solar cells.** Olsen, L.C.; Dunham, G.; Addis, F.W.; Huber, D.; Daling, D. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

The electro-optical characterization of gallium arsenide p/n solar cells is discussed. The objective is to identify and understand basic mechanisms which limit the performance of high efficiency gallium arsenide solar cells. The approach involves conducting photoresponse and temperature dependent current-voltage measurements, and interpretation of the data in terms of theory to determine key device parameters. Depth concentration profiles are also utilized in formulating a model to explain device performance.

501 (N—87-26413, pp vp) **Use of multiple EBIC curves and low voltage electron microscopy in the measurement of small diffusion lengths.** Leon, R.P. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

Accurate evaluations of diffusion lengths for heavily to moderately doped III-V semiconductors and/or radiation damaged solar cells have been made possible by using experimental and numerical techniques. The techniques employed were electron beam induced current and low voltage electron microscopy.

502 (N—87-26413, pp vp) **Results of 1 MeV proton irradiation of front and back surfaces of silicon solar cells.** Anspaugh, B.E.; Kachare, R.; Weizer, V.G. (Jet Propulsion Lab., Pasadena, CA). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

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Several silicon solar cells with and without back surface fields (BSF), having thicknesses of 200 microns and 63 microns, were irradiated with 1 MeV protons having fluences between 1 times 10 to the 10th power and 1 times 10 to the 12th power p/square cm. The irradiation was performed using both normal and isotropic incidence on the front as well as back surfaces of the solar cells. The results of the back surface irradiations are analyzed using a model in which irradiation induced defects across the high-low (BSF) junction are considered. It is concluded that degradation of the high-low junction is responsible for the severe performance loss in thinner cells when irradiated from the rear.

503 (N—87-26413, pp vp) **Effect of 1.0 MeV electron irradiation on shunt resistance in Si-MINP solar cells.** Anderson, W.A.; Banerjee, S. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

Shunt resistance from 100 K to 400 K is compared for diffused and ion implanted cells before and after irradiation. R/sub sh/ decreases from greater than 10 to the 7th power omega-square cm for T less than 250 K to 10 to the 4th power omega-square cm at 400 K for non-irradiated diffused cells. Electron irradiation causes a more rapid decrease in R/sub sh/ for T greater than 250 K. Ion implanted cells exhibit a similar trend except that R/sub sh/ is significantly less for T less than 250 K and is more sensitive to irradiation at these low temperatures. The mechanism of R/sub sh/ appears to be a combination of multistep tunneling and trapping - detrapping in the defect states of the semiconductor. Radiation serves to increase the density of these states to decrease R/sub sh/.

504 (N—87-26413, pp vp) **Radiation damage of gallium arsenide production cells.** Mardesich, N.; Joslin, D.; Garlick, J.; Lillington, D.; Gillanders, M.; Cavicchi, B.; Scott-Monck, J.; Kachare, R.; Anspaugh, B. (Jet Propulsion Lab., Pasadena, CA). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

High efficiency liquid phase epitaxy (LPE) gallium arsenide cells were irradiated with 1 Mev electrons up to fluences of 1 times 10 to the 16th power cm-2. Measurements of spectral response and dark and illuminated I-V data were made at each fluence and then, using computer codes, the experimental data was fitted to gallium arsenide cell models. In this way it was possible to determine the extent of the damage, and hence damage coefficients in both the emitter and base of the cell.

505 (N—87-26413, pp vp) **Performance of AlGaAs, GaAs and InGaAs cells after 1 MeV electron irradiation.** Curtis, H.B.; Hart, R.E. Jr. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

Electron irradiations were made on three different types of III-V cells. AlGaAs, GaAs, and InGaAs cells with bandgaps of approximately 1.72, 1.43, and 1.1 eV, respectively. All of the cells were concentrator cells and performance data from one sun to beyond 100x AMO were taken. The total 1 MeV electron fluence was 3 times 10 to the 15th power e/square cm with data taken at several intermediate fluences. Cell performance is presented as a function of electron fluence for various concentration ratios and two different temperatures (25 and 80 C). Since these three cell types are potential candidates for the individual cells in a cascade structure, it is possible to calculate the loss in performance of cascade cells under 1 MeV irradiation. Data are presented which show the calculated performance of both series-connected and separately connected cascade cells.

506 (N—87-26413, pp vp) **Calculations of the displacement damage and short-circuit current degradation in proton irradiated (AlGa)As-GaAs solar cells.** Yeh, C.S.; Li, S.S.; Loo, R.Y. (Hughes Research Labs., Malibu, CA). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

A theoretical model for computing the displacement damage defect density and the short-circuit current (I/sub sc/) degradation in proton-irradiated (AlGa)As-GaAs p-n junction solar cells is presented. Assumptions were made with justification that the radiation induced displacement defects form an effective recombination center which controls the electron and hole lifetimes in the junction space charge region and in the n-GaAs active layer of the irradiated GaAs p-n junction cells. The degradation of I/sub sc/ in the (AlGa)As layer was found to be negligible compared to the total degradation. In order to determine the I/sub sc/ degradation, the displacement defect density, path length, range, reduced energy after penetrating a distance x, and the average number of displacements formed by one proton scattering event were first calculated. The I/sub sc/ degradation was calculated by using the electron capture cross section in the p-diffused layer and the hole capture cross section in the n-base layer as well as the wavelength dependent absorption coefficients. Excellent agreement was found between the researchers calculated values and the measured I/sub sc/ in the proton irradiated GaAs solar cells for proton energies of 100 KeV to 10 MeV and fluences from 10 to the 10th power p/square cm to 10 to the 12th power p/square cm.

507 (N—87-26413, pp vp) **Status of indium phosphide solar cell development at Spire.** Spitzer, M.B.; Keavney, C.J.; Vernon, S.M. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

On-going development of indium phosphide solar cells for space applications is presented. The development is being carried out with a view towards both high conversion efficiency and simplicity of manufacture. The cell designs comprise the ion-implanted cell, the indium tin oxide top contact cell, and the epitaxial cell grown by metal organic chemical vapor deposition. Modelling data on the limit to the efficiency are presented and comparison is made to measured performance data.

508 (N—87-26413, pp vp) **Comparative performance of diffused junction indium phosphide solar cells.** Weinberg, I.; Swartz, C.K.; Hart, R.E. Jr.; Ghandhi, S.K.; Borrego, J.M.; Parat, K.K. (Rensselaer Polytechnic Institute, Troy, NY). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

A comparison is made between indium phosphide solar cells whose p-n junctions were processed by open tube capped diffusion, and closed tube uncapped diffusion, of sulfur into Czochralski grown p-type substrates. Air mass zero, total area, efficiencies ranged from 10 to 14.2 percent, the latter value attributed to cells processed by capped diffusion. The radiation resistance of these latter cells was slightly better, under 1 MeV electron irradiation. However, rather than being process dependent, the difference in radiation resistance could be attributed to the effects of increased base dopant concentration. In agreement with previous results, both cells exhibited radiation resistance superior to that of gallium arsenide. The lowest temperature dependency of maximum power was exhibited by the cells prepared by open tube capped diffusion. Contrary to previous results, no correlation was found between open circuit voltage and the temperature dependency of Pmax. It was concluded that additional process optimization was necessary before concluding that one process was better than another.

509 (N—87-26413, pp vp) **ITO/InP solar cells: a comparison of devices fabricated by ion beam and RF sputtering of the ITO.** Coutts, T.J. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

This work was performed with the view of elucidating the behavior of indium tin oxide/indium phosphide (ITO/InP) solar cells prepared by RF and ion beam sputtering. It was found that using RF sputter deposition of the ITO always leads to more efficient devices than ion beam sputter deposition. An important aspect of the former technique is the exposure of the single crystal p-InP substrates to a very low plasma power prior to deposition. Substrates treated in this manner have also been used for ion beam deposition of ITO. In this case the cells behave very similarly to the RF deposited cells, thus suggesting that the lower power plasma exposure (LPPE) is the crucial process step.

510 (N—87-26413, pp vp) **Near-optimum design of the InP homojunction solar cell.** Goradia, C.; Geier, J.V.; Weinberg, I. (Cleveland State Univ., OH). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

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Using a fairly comprehensive model, researchers have done a parametric variation study of the InP n+p homojunction solar cell for AMO, 25 C operation. The results of this study are presented. These results indicate that an efficiency of about 25 percent should be realistically possible in a shallow homojunction InP solar cell with near-optimum design.

511 (N—87-26413, pp vp) **Solar cells in bulk InP using an open tube diffusion process.** Parat, K.K.; Bothra, S.; Borrego, J.M.; Ghandhi, S.K. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

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A simple open tube diffusion technique for the fabrication of n+p junction solar cells is described. Large area (greater than 0.25 square cm) solar cells have been made by this process with a photovoltaic conversion efficiency of 15.2 percent under simulated AMO illumination. An ideality factor is 1.04 and a saturation current density of 9.6 times 10 to the minus 16th power A/square cm have been observed for these cells. These are the lowest (best) values reported to date for diffused structures in bulk InP.

512 (N—87-26413, pp vp) **P/N InP homojunction solar cells by LPE and MOCVD techniques.** Choi, K.Y.; Shen, C.C.; Miller, B.I. (Bell Telephone Labs., Inc., Princeton, NJ). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

P/N InP homojunction solar cells have been prepared by using both liquid phase epitaxy (LPE) and metallorganic chemical vapor deposition (MOCVD) growth techniques. A heavily doped p-In/sub 0.53Ga 0.47As/ contacting layer was incorporated into

the cell structure to improve the fill factor and to eliminate surface spiking at the front surface. The best conversion efficiencies (total area) obtained under AM 1 illumination are 14.2 percent for a LPE cell and 15.4 percent for a MOCVD cell.

513 (N—87-26413, pp vp) **Overview of the DOE terrestrial crystalline solar cell research program.** Gee, J.M.; Arivizu, D.E. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

There has been significant progress in the crystalline solar cell area in the past two years that has rejuvenated interest in the high efficiency devices for terrestrial photovoltaic systems. The most significant developments have been in the crystalline solar cell area, but progress in the III-V area has also been recorded. A review of terrestrial crystalline cell research is presented along with a description of future research directions.

514 (N—87-26413, pp vp) **GaAs high efficiency limits/geometric enhancements.** Spitzer, M. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

This workshop addressed efficiency improvements that may be obtained in GaAs solar cells. The cell designs considered by the group ranged from conventional planar structures to novel devices employing superlattices or point contacts.

515 (N—87-26413, pp vp) **Device modeling.** Schwartz, R. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

A summary report is given of the activities of the device modeling workshop which was held as a part of the Space photovoltaic research and technology Conference at the Lewis Research Center, October 7 to 9, 1986. The purpose of this workshop was to access the status of solar cell device modeling to see if it is meeting present and future needs of the photovoltaic community.

516 (N—87-26413, pp vp) **High power/large area PV systems.** Wise, J.; Baraona, C. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH.). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

The major photovoltaic power system technology drivers for a wide variety of mission types were ranked. Each technology driver was ranked on a scale of high, medium, or low in terms of importance to each particular mission type. The rankings were then compiled to determine the overall importance of each driver over the entire range of space missions. In each case cost was ranked the highest.

517 (N—87-26413, pp vp) **Opportunities for PV applications.** Scott-Monck, J.A.; Rahilly, W.P. (Aerospace Corp., Los Angeles, CA). Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

Workshop members devoted the majority of time to discussing future prospects for technology support of photovoltaic applications. Photovoltaics has provided power for almost every spacecraft launched in the free world in the last 25 years. Over this time, photovoltaics has demonstrated impressive growth in power level, operating lifetime and specific power (W/kg and W/square m). Yet, the current attitude toward this reliable form of space power generation is likely to preclude further dramatic performance gains.

518 (N—87-26413, pp vp) **InP materials/cell fabrication.** Coutts, T.J. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

The main points of discussion, conclusions and recommendations of a workshop on InP materials and cell fabrication are given. The importance of assessing the quality of p-Inp crystals supplied by different vendors, back contacts to solar cells, junction formation, energy conversion efficiency, testing for radiation resistance, and future develpments were among the topics discussed.

519 (NP—7753263) **Conversion costs of selected product lines in the area of renewable feedstocks from farming.** Barthel, E.; Goetzke, H.; Hennigs, H. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany, F.R.). Inst. fuer Betriebswirtschaft). 1986. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753263/JAW.

The publication is a description of process for converting renewable feedstocks from farming into products fit to be used further for technical purposes. Its main concern is the derivation of conversion costs and the recording of quantity ratios in the conversion range of the individual product lines. After quantifying the respective processing costs, which are calculated on a uniform basis, and taking into account the specific raw material costs of each product line and proceeds from by-products, a comparative evaluation can be made between the product lines sugar, starch, vegetable oils and fats, and ethanol. Such an analysis could yield, for instance, the establishment of an order of sequence for the product lines considered as to their competitive position in the technical field. A further purpose to which these results might be put would be their quantitative evaluation with a view to improving the competitive chances of renewable feedstocks.

520 (NP—7770277) **Assessment of biogas installations in the Federal Republic of Germany. Final report.** Baader, W.; Kloss, R. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany, F.R.)). 1982. 107p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87770277/JAW.

In accordance with the task at hand, the primary aim of the investigation was the gathering of information available about agricultural biogas plants. Beside this, information was also to be incorporated to a small extent about the current position and development of biogas technology in other areas such as municipal and industrial sewage treatment and domestic refuse landfills. In the Federal Republic of Germany, producers and owners of agricultural biogas plants and competent institutions and establishments in the field of biogas technology were contacted and asked for information about existing plants or those in an advanced stage of planning. In order to gain a comprehensive picture of the agricultural plants, the information was obtained directly at each of the 80 plants. With a few exceptions, all farmers were willing to give information about their plants in this inquiry, which was carried out in every case by the same member of the Institute of Technology. In numerous cases, we obtained supplementary data from representatives of the production firm or the supervising institute who were present at the time.

521 (NP—7900914) **Biomass abstracts: Cumulative indexes, 1986.** (Institute for Industrial Research and Standards, Dublin (Ireland). Information Technology Group). 1986. 266p. IEA Biomass Conversion Technical Information Service,, Institute for Industrial Research and Standards, Ballymun Rd., Dublin 9, Ireland. Order Number TI87900914/JAW.

This volume contains the corporate author index, author index, and subject index for publications entered into the IEA Biomass Conversion Technical Information System during the year 1986. (DT)

522 (NP—8750423) **Requirements of small-scale wood- and straw-fired heating systems up to 50 kW.** Braun, H.; Schreier, C.; Woergetter, M.; Wernisch, A. (Oesterreichischen Vereinigung fuer Agrarwissenschaftliche Forschung). 1986. 168p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750423/JAW.

Based on existing knowledge the research program tries to compile specifications for small-scale wood- and straw-fired heating systems up to 50 kW. Emphasis is placed on the following aspects: a) basic principles of wood and straw combustion, b) the systematics of wood and straw burning furnaces, c) the systematics and control principles of water heating systems, d) state of the art, e) requirements on the part of the user, f) compilation of specifications according to the state of the art and according to legal requirements, g) scheme for optimized small-scale heating systems on the basis of specifications and information obtained from the manufacturers.

523 **(ORNL/TM—10521) Plant cell tissue culture: A potential source of chemicals.** Scott, C.D.; Dougall, D.K. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000036/JAW.

Higher plants produce many industrially important products. Among these are drugs and medicinal chemicals, essential oils and flavors, vegetable oils and fats, fine and specialty chemicals, and even some commodity chemicals. Although, currently, whole-plant extraction is the primary means of harvesting these materials, the advent of plant cell tissue culture could be a much more effective method of producing many types of phytochemicals. The use of immobilized plant cells in an advanced bioreactor configuration with excretion of the product into the reactor medium may represent the most straightforward way of commercializing such techniques for lower-value chemicals. Important research and development opportunities in this area include screening for plant cultures for nonmedical, lower-value chemicals; understanding and controlling plant cell physiology and biochemistry; optimizing effective immobilization methods; developing more efficient bioreactor concepts; and perfecting product extraction and purification techniques. 62 refs., 2 figs.

524 **(PB—87-224358/XAB) Environmental source book on the photovoltaics industry. Final report, February-July 1986.** Moskowitz, P.D.; Kalb, P.D.; Lee, J.C.; Fthenakis, V.M. (Brookhaven National Lab., Upton, NY (USA)). Jul 1987. 97p. NTIS, PC A05/MF A01.

This report gives background information on the photovoltaics industry to help the U.S. EPA evaluate premanufacture notice (PMN) and significant new use regulation (SNUR) submittals from the industry. It also gives information for photovoltaics industry on the Toxic Substances Control Act (TSCA) compliance requirements. This industry uses a large diversity of toxic and hazardous chemicals. Attention is currently focused on such gases as silane, phosphine, arsine, diborane, and hydrogen selenide which may be used in large quantities and for which there is limited industrial experience. Most materials used by the industry are already listed in the TSCA Inventory List. Unlisted compounds are used as feedstocks or are the actual products themselves. Manufacturers using or producing unlisted materials must apply to the EPA for a PMN. Some materials (especially those defined to be acutely toxic) contained in the Inventory List may be used in larger quantity or in applications which differ from current industrial use; these are potential candidates for SNUR.

525 **(PNFI—X-71) Plantation white spruce variable density volume and biomass yield tables to age 60 at the Petawawa National Forestry Institute.** (SEE CODE- 8700100 Petawawa National Forestry Inst., Chalk River, Ontario (Canada)). 1987. 21p. (MICROLOG—87-02631). Petawawa National Forestry Institute, Technical Information and Distribution Centre, Chalk River, Ontario, Canada K0J 1J0; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

Recent measurements of sample plots in white spruce plantations at the Petawawa National Forestry Institute were used to update and revise previously published yield tables. Those presented cover 20 to 60 years from planting by 5-year age classes, six planted spacings, and five site index classes. The data shown for each site index-age-spacing combination are dominant height, average height, number of trees, mean diameter, total basal area, total volume, merchantable volume, mass of total tree above ground, mass of main stem including bark, and mass of merchantable stem including bark. 7 refs., 2 figs., 6 tabs.

526 (SERI/SP—231-3071, pp 227-248) **Evaluation of available saline water resources in New Mexico for the production of microalgae.** Lansford, R.R.; Hernandez, J.W.; Enis, P. (New Mexico State Univ., Las Cruces). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

The major objective of the research was to select potential sites for 1000-hectare (2470 acre) microalgae production facilities in New Mexico using saline water resources. First, a data base was created with respect to the Solar Energy Research Institute (SERI) criteria for location of microalgae production facilities in New Mexico. Specific criteria included location, depth-to-water, aquifer characteristics, saturated thickness of aquifers, salinity, ionic composition, well-yields, growing season, topography, and land ownership. Second, the data base was digitized for map construction. The desirable water supply for algae culture was limited to moderately or more saline ground waters (3000 mg/l total dissolved solids or greater), because of the existing societal demands for the limited supply of better quality water. After a review of the location of the 15 billion acre-feet of saline water resources in the state, areas that appeared to generally meet the SERI criteria for site selection were narrowed to the following - the Tularosa Basin in south-central New Mexico, the Estancia Basin in central New Mexico, the San Juan Basin in northwestern New Mexico, the Tucumcari area in Quay County on the east side of New Mexico, the area east of the Pecos River Basin in eastern New Mexico, and the Crow Flats area in southern New Mexico. A detailed analysis was completed for the six locations. Three basins were eliminated for failing to meet all the criteria developed for the study. Of the remaining basins, the Tularosa was judged best suited for a micro-algae production facility, Crow Flats, the next best, and Estancia, the poorest of the three choices because of a short growing season. 5 references, 5 figures, 4 tables.

527 **Energy conversion system.** Murphy, L.M. (to Dept. of Energy, Washington, DC). US Patent 4,691,075. 1 Sep 1987. Filed date 16 Sep 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a light-weight and self-contained solar energy conversion apparatus for converting solar radiation to electrical energy, which consists of: an array of photovoltaic cells mounted on a thin film substrate membrane and connected together to provide an electric power source, the thin film being stretched and mounted on a circular rim; support means connected to the rim for supporting the array of photovoltaic cells in a position adapted to be exposed to solar radiation, the support means being adjustable about two orthogonal axes and having strength design parameters sufficient to support the array, substrate membrane, and rim safely in a still atmosphere without regard to ambient outside wind and hail loads; and a substantially spherical dome positioned over and enclosing a chamber around the array of photovoltaic cells and support means, the dome being comprised of a specularly translucent, flexible, thin film material anchored around the support means and inflated to a pressure in the chamber in the range of about 0.02 to 0.10 pounds per square inch more than the pressure outside the chamber. The thin film material of the dome is also tear-resistant and sufficiently strong to withstand normal wind and hail storm forces and having sufficient resilience to yield without puncturing to hail stones, yet to recover to its spherical surface shape under the urging of the inflation pressure in the chamber.

528 **(AD-A—183039/7/XAB) High-efficiency silicon solar cell (selected portions).** Shi, J. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 22 Jul 1987. Trans. of Huazhong Gongxueyuan Xuebao (China), No. 4, 67-69, 72(1984) by Randy Dorsey. (FTD-ID(RS)T—1056-86). 9p. NTIS, PC A02/MF A01.

This research work on high-efficiency silicon solar cells began with raising circuit voltage as well as assisting with certain measures to improve short circuit current density and fill factor. The cells developed had their total surface area efficiency measured at 18.7% in evaluation tests at the Solar Research Institute in Colo-

rado. This is the highest value obtained by a silicon cell measured at this institute. It is a relatively large improvement compared to the efficiency of silicon cells measured by similar methods previously published. As a result of using such measures as surface-passivation technology, circuit voltage has been increased. As a result of high circuit voltage and low series resistance, extremely high fill factors were achieved. As a result of employing designs such as double layer, anti-reflective film and decreasing electrode shading area, short-circuit current density was increased.

529 **Labeling quinone-binding sites in photosynthetic reaction centers: a 38-kilodalton protein associated with the acceptor side of photosystem II.** Worland, S.T.; Yamagishi, A.; Isaacs, S.; Sauer, K.; Hearst, J.E. (Lawrence Berkeley Lab., CA). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 7, 1774-1778(Apr 1987). Contract AC03-76SF00098.

2-Acetoxymethyl-1,4-naphthoquinone (2-AcOMeNQ) binds with rapid kinetics and high affinity to the primary quinone Q/sub A/ site of reaction centers from Rhodopseudomonas capsulata. Binding of 2-AcOMeNQ fully restores electron-transfer activity with kinetics that is similar, but not identical, to that seen with ubiquinone-50. When bound at the Q/sub A/ site, 2-AcOMeNQ preferentially labels the L subunit. This preference suggests that 2-AcOMeNQ labels primarily the region of a quinone-binding site that is close to the first isoprenoid unit of the side chain, which is expected from the location and structure of the reaction region of the molecule. In photosystem II particles from Synechococcus sp., 2-AcOMeNQ primarily labels two polypeptides with apparent molecular masses of 38 and 19 kDa. Labeling of only the 38-kDa polypeptide is sufficiently sensitive to 3-(3,4-dichlorophenyl)-1,1-dimethylurea (DCMU) to conclude that it is involved in binding quinones on the acceptor side of photosystem II. Although the authors have not yet identified the 38-kDa protein, its properties suggest that it is the D2 protein. From the DCMU-sensitive labeling and from homologies to functionally important regions of the bacterial reaction-center subunits, they propose that the 38-kDa protein is intimately involved in binding the cofactors that mediate primary photochemistry.

530 **Catalysts for gasification of biomass.** Mudge, L.K.; Baker, E.G.; Brown, M.D.; Wilcox, W.A. (Pacific Northwest Lab., Richland, WA). pp 1639-1640 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—). Contract AC06-76RL01830.

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

The U.S. Department of Energy, Thermochemical Conversion Program, sponsored studies at the Pacific Northwest Laboratory under contract DE-AC06-76RL01830 on development of catalysts for conversion of biomass to high-valued gas products. Bench scale studies using dual fluid bed reactors in series developed catalysts with a long active lifetime. Conditions for catalyst testing were based on results of previous studies in a fluid bed process research unit. Supported metal catalysts were developed that remained active indefinitely at 750°C for destroying tars in wood-derived gases. Active catalysts included NiCuMo on silica-alumina and Ni on a α-alumina. These catalysts remained active when contacting wood-derived gases in a secondary fluid bed reactor. Potential applications for catalysts in biomass gasification include their use to improve synthesis gas yields and to simplify wastewater cleanup problems in commercial gasification processes. The catalysts are effective for reducing the organic carbon content in condensate streams.

531 **Production of oxygenated fuels from municipal solid waste components.** Agrawal, R.K.; Helt, J.E. (Chemical Technology Div., Argonne National Lab., Argonne, IL 60439). pp 1691-1694 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

There is a worldwide concern over both future energy supplies and the disposal of municipal solid wastes (MSW). Most MSW is cellulosic in nature, comprising paper, newsprint, packaging materials, wood wastes, and yard clippings. Investigation of the basic mechanisms of pyrolysis of these materials is being undertaken in both a TGA and a bench-scale, fixed-bed reactor which generates adequate quantities of gaseous and liquid products to allow them to be characterized analytically. The end products of MSW pyrolysis are: a highly carbonaceous solid char, a highly oxygenated liquid tar, and a mixture of gases with low to medium Btu content. Depending on the type of fuel preferred, the pyrolysis conditions can be varied to maximize the desired product yield. Experimental results on the thermal decomposition of MSW components (Whatman #1, newsprint, kraft paper, and cardboard) over a temperature range of 275-475°C have been gathered. From product distributions during exploratory runs indications are that heating rate (for the range studies, 5-35°C/min) has no significant effect on the yields. However, the final temperature of the pyrolysis reaction does have a significant effect on the yields of the various products.

532 **Influence of nitrogen and temperature on lipid production in microalgae (Hantzschia DI-160).** Sriharan, S.; Bagga, D. (Science Div., Selma Univ., Selma, AL 36701). pp 1689-1690 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

Chrysophytes (microalgae-diatoms) are known to accumulate large quantities of various lipid types. The objectives of the studies reported here are to evaluate the effect of induction strategies (varying nitrogen concentrations and temperature) on the lipid production in diatom, Hantzschia DI-160. The analytical results show that the AFD at 30°C was 11.420 g/L and 1.120 g/L in NS and ND treatments respectively. At 20°C, the AFD was 0.998 g/L and 0.885 g/L in NS and ND respectively. The total lipids were 0.070 g/L and 0.092 g/L at 30°C; 0.054 g/L and 0.071 g/L at 20°C in NS and ND conditions respectively. The neutral lipids were 0.044 g/L and 0.058 g/L at 30°C; 0.032 g/L and 0.043 g/L at 20°C in NS and ND experimental groups. The polar lipids were 0.026 g/L and 0.032 g/L at 30°C; whereas at 20°C these values were 0.022 g/L and 0.027 g/L in NS and ND treatments. The results suggest that by growing Hantzschia DI-160 in nitrogen limited medium, the yield of lipid content may be increased.

533 **Fuels from microalgae: An assessment of technology requirements.** Neenan, B.F.; Feinberg, D.A. (Solar Energy Research Institute, Golden, CO 80401). pp 1293-1308 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

The Aquatic Species Program (ASP), field managed for the U.S. Department of Energy (DOE) by the Solar Energy Research Institute (SERI), seeks to develop the technology for production of liquid fuels form aquatic plants, primarily microscopic algae. As part of this program, and extensive technology evaluation was performed to determine the extent to which microalgae might replace conventional petroleum-based liquid fuels by the early 21st century, as well as to delineate the critical research areas and issues that must be resolved before such replacements could occur. Several aspects of the overall technology evaluation are discussed in this paper. Two critical methodological decisions were made in the performance of this work: (1) that the multivariate nature of technology evaluation precludes the reduction of alternative configurations to a single-valued measure of worth; and, (2) that the technology evaluation team must reconcile the perspective of the scientists with that of the decision makers. Therefore, the approach chosen includes the development of a series of detailed technology configurations, and attempts to present the results and requirements of these options as dispassionately as possible. The result of such an approach is to turn the data over to the decision makers, allowing them to seek their own expert consensus on the likelihood of success of each technology configuration.

534 **Light soaking behavior of a-Si:H p-i-n solar cells.** Tsuo, Y.S.; Xi, J.P.; McMahon, T.J. (Solar Energy Research Institute, Golden, CO). pp 165-170 of Stability of amorphous silicon alloy materials and devices. Stafford, B.L.; Sabisky, E. (eds.). New York, NY; American Institute of Physics (1987). (CONF-870116—). Contract AC02-83CH10093.

From International conference on stability of amorphous silicon alloy materials and devices; Palo Alto, CA, USA (28 Jan 1987).

The authors have studied the effects of light soaking on p-i-n a-Si:H solar cells. They find that degradation is much greater when light soaking and cell measurements are both done through the n-layer rather than through the p-layer. A slight increase in the short-circuit current was observed whenever a sample soaked with blue or white light through the p-layer was also measured through the p-layer. The relative increase of the short-circuit current is greater with larger i-layer thicknesses.

535 **Response of amorphous silicon cells to reverse biasing.** Gonzalez, C.; Ross, R.G. Jr. (Jet Propulsion Lab., Pasadena, CA). pp 342-349 of Stability of amorphous silicon alloy materials and devices. Stafford, B.L.; Sabisky, E. (eds.). New York, NY; American Institute of Physics (1987). (CONF-870116—).

From International conference on stability of amorphous silicon alloy materials and devices; Palo Alto, CA, USA (28 Jan 1987).

This paper discusses the results of a study to determine the hot-spot susceptibility of amorphous silicon cells and modules, and to provide guidelines and develop a qualification test for reducing module hot-spot susceptibility. Amorphous cells are shown to have hot-spot susceptibility levels similar to crystalline-Si cells leading to the fact that the same general guidelines apply for protecting amorphous cells from hot-spot stressing as apply to crystalline-Si cells. Recommendations are made on ways of reducing module hot-spot susceptibility including the traditional method of using bypass diodes and a method unique to thin-film cells, limiting the string current by limiting the cell areal size.

536 **Amorphous-silicon module intercell corrosion.** Mon, G.R.; Ross, R.G. Jr. (Jet Propulsion Lab., Pasadena, CA). pp 350-357 of Stability of amorphous silicon alloy materials and devices. Stafford, B.L.; Sabisky, E. (eds.). New York, NY; American Institute of Physics (1987). (CONF-870116—).

From International conference on stability of amorphous silicon alloy materials and devices; Palo Alto, CA, USA (28 Jan 1987).

Three non-electrochemical, moisture-induced a-Si module degradation modes have been observed and their mechanisms studied: (1) the formation and growth of pinholes in the thin-film layers; (2) the directional interfusion of pinholes along process scribe lines to form metallization-free regions that tend to open-circuit the module; and (3) worm-like filiform corrosion in the aluminum layer. The dependency on time-of-exposure to moist environments of the amount of material erosion in the module intercell zone has been quantified by two methods - directly by EDS analysis, and indirectly by sheet resistivity measurements on fully aluminized back surface modules. In addition, changes in maximum power output, series resistance, and open circuit voltage have been documented. Consequences for fielded modules are discussed.

537 **Long-term experimental testing of a-silicon modules.** Ross, R.G. Jr.; Sugimura, R.S. (California Institute of Technology, Pasadena). pp 358-365 of Stability of amorphous silicon alloy materials and devices. Stafford, B.L.; Sabisky, E. (eds.). New York, NY; American Institute of Physics (1987). (CONF-870116—).

From International conference on stability of amorphous silicon alloy materials and devices; Palo Alto, CA, USA (28 Jan 1987).

Long-term stability of photovoltaic module electrical performance is critically important to the economic viability of PV in large-scale energy-generation applications. Equally important is having the means to conclusively demonstrate long life to potential users; this requires proven test methods that accurately predict field performance trends. To assess the long-term stability of a-Si modules and the usefulness of existing crystalline-Si test methods a number of first generation a-Si photovoltaic modules have been acquired from leading manufacturers and subjected to a variety of accelerated and real-time outdoor aging tests. Data to date indicate that the degradation of a-Si modules involves complex dependencies that negate some of the key test correlations previously established for crystalline-Si modules. Key research priorities are highlighted including light induced effects, cell corrosion leading to increased series resistance, glass breaking strength for large modules, and the development of protective encapsulants that meet the outdoor weathering and voltage isolation required for long module life.

538 **The potential for growing terrestrial energy crops in the southwest United States.** Salk, M.S.; Folger, A.G. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 277-304 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—). Contract AC05-84OR21400.

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

The southwest United States - an area of diverse climate, topography, terrain, soils, and vegetation - was assessed to determine which parts of the region would be suitable for growing terrestrial energy crops and then to characterize those areas. Minimal conditions for biomass energy crop production were considered to be an average annual precipitation of at least 30 cm (12 in.) and a frost-free period of at least 120 days per year. Approximately 7.7 x 10/sup 7/ ha (19.1 x 10/sup 7/ acres), just over 40% of the study region, met both criteria. The data compiled for this study can be used both to provide a set of species for screening as biomass energy crops for the Southwest and to identify areas in this region where previously selected energy crops would grow best. Species found to perform best in a given set of environmental conditions can be identified and exploited rather than attempting to alter the environment to suit the needs of preselected plant species. Species with some or all of the following characteristics would be the most likely biomass energy crops in the Southwest: sprout from roots or stumps, have C/sub 4/ or crossulacean acid metabolism photosynthesis, fixed nitrogen, are perennial, withstand moisture limitations and other climatic extremes, have multiple uses, and produce valuable by-products.

539 **Application of cell and tissue culture techniques for the genetic improvement of sorghum, Sorghum bicolor.** Kresovich, S.; Mc Gee, R.E.; Panella, L.W.; Reilley, A.A.; Miller, F.R. (Texas Agricultural Experiment Station, Weslaco, TX 78596). pp 261-276 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

During the past two decades, an integration of plant biochemistry, plant physiology, and molecular biology has allowed for the development of basic cell and tissue culture techniques, which have the potential of improving understanding of plant biology. The objective of this paper is to present the "state of the art" with regard to the use of these techniques for the genetic improvement of sorghum. Much of what has been accomplished to date has been based in empiricism and the fundamental understanding of the biology of the sorghum plant is limited. Nonetheless, in the short-term these techniques provide model systems for the study of development biology and stress physiology. As "problem oriented" basic research becomes focused, cell and tissue culture techniques may be useful to improve understanding of the genetics of sorghum, to elicit and control desired variability, and to serve as a selection tool in improvement programs.

540 **Prospects for commercialization of eucalyptus biomass plantations in Florida.** Rockwood, D.L.; Dippon, D.R. (Dept. of Forestry, Univ. of Florida, Gainesville, FL 32611). pp 233-250 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

Eucalyptus biomass plantations are to be commercially viable in Florida when productivity is assured, harvesting is economical, and markets are established. To date, substantial increases

in yields have been achieved through genetic selection and cultural options, harvested and transported biomass is estimated to have very positive economic and energetic ratios, and utilization of woody biomass for energy is increasing. Achieved yields have been as high as 23 dry Mg/ha/yr. In southern Florida, E. grandis has grown well on drained organic and seasonally wet sandy soils, and coppice yields may be equal or greater if harvests are properly timed and conducted. For central Florida, E. camaldulensis can be very productive on sandhills sites and may have suitable frost-hardiness. On agricultural sites in northern Florida, E. amplifolia has excellent frost-resiliency and coppicing. Genetic selection promises to increase productivity and frost resistance and vegetative propagation may be effective in realizing near-term potential. High quality E. grandis seed may be obtained from a 17 ha seed orchard, and four clones combine frost resistance with good growth. Several E. camaldulensis sources appear well adapted, and some excellent clones have been selected. Sources of E. amplifolia differ in frost resistance and growth. Associated inputs and costs suggest that short-rotation, close spacing culture can make woody biomass competitive with other feedstocks available for energy generation. Breakeven costs per delivered Gj range from just under $2.00 for E. grandis in 2-year rotations on muck soils and for E. amplifolia in 3-year cycles on agricultural lands to under $4.00/Gj for E. grandis on prairie and E. camaldulensis on sandhills.

541 **The role of genetic improvement in the Short Rotation Woody Crops Program.** Layton, P.A.; Wright, L.L. (Short Rotation Woody Crops Program, Environmental Sciences Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 133-154 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—). Contract AC05-84OR21400.

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

The U.S. Department of Energy is sponsoring a long-range research program, the Short Rotation Woody Crops Program (SRWCP), to develop short-rotation intensive culture (SRIC) approaches to woody biomass energy production. A major effort in the SRWCP is species screening and genetic improvement of selected species. Of the 125 species initially evaluated for SRIC, only 20 are being seriously considered now, with most of the emphasis in the SRWCP being on 16 hardwood species. Genetic improvement is viewed as a major tool for increasing productivity, having anticipated gains of 40 to 50%. In addition to breeding, the techniques of somaclonal screening and genetic engineering are being evaluated for their usefulness in the SRIC improvement program. Currently, salt-tolerant Atriplex canescens (four-wing saltbush) and herbicide-resistant Populus spp. are being sought via somaclonal screening. The SRWCP plans to increase the emphasis on genetic improvement of SRIC species through new initiatives encouraging use of a combination of classical breeding techniques and biotechnology.

542 **Forest resource availability: Modeling the supply curves.** Shen, S. (Argonne National Lab., Argonne, IL 60439). pp 115-120 of Energy from biomass and waste X. Klass, D.L. Chicago, IL; Institute of Gas Technology (1987). (CONF-860405—).

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

The author analyzes considerations that allow one to model the supply curves of energy wood as a coproduct of other forest-product wood. Examples in the Midwest are used to illustrate components of the model. It is pointed out that regional supply curves are not useful for most analyses and supply curves for marketing regions should be the target. These supply curves can be obtained by developing a harvesting model and applying it to a dynamic forest growth model.

543 **Opportunities for increased efficiency for single- and multijunction polycrystalline thin-film solar cells.** Hermann, A.; Zweibel, K.; Jackson, B.; Mitchell, R. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 132-137 of Materials and new processing technologies for photovoltaics. Kapur, V.K.; Dismukes, J.P.; Pizzini, S. Pennington, NJ; The Electrochemical Society (1985). (CONF-841058—).

From Fall meeting of the Electrochemical Society; New Orleans, LA, USA (7 Oct 1984).

For photovoltaics (PV) to become a viable energy option, PV-generated electricity must demonstrate parity with electricity from competing conventional alternatives. As a guide toward achieving this parity, long-term PV research goals have been developed by the U.S. Department of Energy. A 1987 efficiency goal of 15% has been established for thin-film polycrystalline solar cells. Figure 1 shows state-of-the-art efficiencies for CdS/CuInSe/sub 2/ and CdS/CdTe polycrystalline devices, which are presently near the 11% mark. This paper describes efficiency-enhancement opportunities for these heterojunctions and for multijunction devices with CuInSe/sub 2/ bottom cells. Evidence of the CuInSe/sub 2/ technology's potential for low-cost production is discussed.

544 **Thin-film tandem solar cells.** Phillips, J.E.; Birkmire, R.W.; Di Netta, L.C.; Meakin, J.D. (Institute of Energy Conversion, Univ. of Delaware, Newark, DE 19716). pp 163-172 of Materials and new processing technologies for photovoltaics. Kapur, V.K.; Dismukes, J.P.; Pizzini, S. Pennington, NJ; The Electrochemical Society (1985). (CONF-841058—).

From Fall meeting of the Electrochemical Society; New Orleans, LA, USA (7 Oct 1984).

A monolithic optically and electrically coupled tandem solar cell has been made with polycrystalline thin-film materials. The component cells are CdS/CdTe and CdS/CuInSe/sub 2/ heterojunctions made by physical vapor deposition. To date, a device of 3% efficiency with an open circuit voltage over 1 volt and a short circuit of 6 mA/cm/sup 2/ at 87.5 mW/cm/sup 2/ has been made. The CuInSe/sub 2//CdTe/CdS device demonstrates that a two cell multi-bandgap tandem structure can be made from single junction polycrystalline thin-film solar cells. The cell structure and production process must result in a transparent ohmic interconnect between the two cells and the process for making the second device must not adversely affect the initial cell. Within these restrictions it should be possible to build thin-film polycrystalline tandem devices with a substantially higher efficiency than their single junction counterparts.

545 **An economic analysis method for short-rotation forestry.** Vyas, A.D.; Shen, S.Y. (Argonne National Lab., Energy and Environment Systems Div., Argonne, IL 60439). pp 1-16 of Proceedings of the 2nd national conference on renewable energy technologies. San Juan, PR; Center for Energy and Environmental Research (1983). (CONF-8308231—).

From 1. Pan American conference on energy and 2nd national conference on renewable energy technologies; San Juan, Puerto Rico (1 Aug 1983).

A method for economic analysis of short-rotation forestry is presented in this paper; a model that employs linear complementarity optimization is an important component of this method. Given data on biomass production costs and methods for short-rotation forestry, the model selects the rotation period (i.e., harvesting cycle) that maximizes the net present value of all future profits for a specified discount rate. The ability to select the optimal rotation period is a unique feature of the model. The model's output, combined with independent analysis of the effect of tree spacing on production costs and woody biomass yield, allows specification of least-cost production systems for short-rotation forestry. The results of analyses of three hypothetical forestry plantations in the United States are summarized here. These results, while obtained for specific species and growing conditions, support three general conclusions regarding short-rotation forestry. For conventional straight-row planting of trees at a 4 x 4 ft (1.2 x 1.2 m) spacing, forage harvesting is more economical than whole-tree harvesting. Production costs for this planting strategy can be further reduced through an alternative harvesting technique that uses an innovative circular saw harvester now under development. Short-rotation forestry costs can be minimized, however, by adopting a planting approach in which seedling cuttings are sown as grass seeds are sown - randomly and very densely - and year-old saplings are forage harvested.

546 **(NP-tr—7900995) An investigation of the variation in the chemical composition and physical properties of spruce and corn cob material during hydrolysis using dilute sulfuric acid.** Ulyanovskaya, R.I.; Korolkov, I.I. Translated from *Sbornik Trudov, Vsesoyuznyi Nauchno-Issledovatel'skii Institut Gidroliza Rastitel'nykh Materialov ;* **18**: 27-43(1969). 17p. NTIS, PC A02/MF A01. Order Number DE87900995/JAW.

In industrial percolation hydrolysis of plant material, the rate of hydrolysate output significantly decreases during the final stages of the heat run compared to the initial rate of hydrolysis. This phenomenon varies according to materials hydrolyzed. Consequently, the duration of heat runs for various types of hydrolysis pulps is different. In particular, the heat run duration for coniferous wood pulp is 2 to 2.5 hours, while that for corn cob material is 8 to 9 hours. A systematic investigation was conducted to reveal how the heat run causes changes in the properties of coniferous softwood pulp and corn cob pulp. The results of previous investigations on the shrinkage of pulps are provided in addition to results of this investigation. The specific fluid resistance values for spruce and corn cob lignin have been obtained. Based on an investigation of hydrolyzed spruce and corn cob material, this report describes the chemical composition and mechanical strength of these substances, as well as their capability for liquid retention and swelling. 5 refs., 5 figs., 3 tabs.

1406 Photovoltaic Power Systems

547 **(BMFT-FB-T—86-224) Systems for the application of solar, wind and biogas energy in the People's Republic of China. Phase II. Photovoltaic section. Final report.** Maass, K.; Sonnenberger, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); AEG-Telefunken Anlagentechnik, Wedel (Germany, F.R.). Fachbereich Raumfahrt, Neue Technologien). Dec 1986. 47p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750421/JAW.

As part of the German-Chinese cooperation the following PV supplied systems were planned and installed close to Beijing: TV, radio link, telephone, TV transmitter and public address system. Further a drinking water supply system and an irrigation system through means of PV powered deep well pumps were installed. The goal of the Chinese-German cooperation programme is the joint development of systems for use of alternative energy sources based on the exchange and utilization of know-how in order to increase the knowledge and experience of both partners. The operation data obtained during the operation and test phase after installation shall be the base for a technical-economic evaluation of each individual system. See also BMFT-FB-T–86-225; 86-226; 86-227; 86-228. With 11 figs.

548 **(N—87-26144) Space station electrical power system.** Labus, T.L.; Cochran, T.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 19p. (NASA-TM—100140; E—3692; NAS—1.15:100140; IAF—87-234; CONF-8710122—3). NTIS, PC A02/MF A01.

From 38. congress of the International Astronautical Federation; Brighton, UK (10 Oct 1987).

The purpose of this paper is to describe the design of the Space Station Electrical Power System. This includes the Photovoltaic and Solar Dynamic Power Modules as well as the Power Management and Distribution System (PMAD). In addition, two programmatic options for developing the Electrical Power System will be presented. One approach is defined as the Enhanced Configuration and represents the results of the Phase B studies conducted by the NASA Lewis Research Center over the last two years. Another option, the Phased Program, represents a more measured approach to reaching about the same capability as the Enhanced Configuration.

549 **(N—87-26413, pp vp) Air Force and DOD solar power requirements.** Wise, J.F. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

It is noted that future power requirements are increasing for some expanded and new missions within the Air Force and Department of Defense. New requirements are needed in terms of lifetime, survivability, power level and performance. The photovoltaic arrays have a demonstrated record of reliable performance, life, affordable cost, and utility. It is argued that there is a need to push for the research and development resources needed to develop the technology base for these future power system needs.

550 (N—87-26413, pp vp) **Space station power system.** Baraona, C.R. Jun 1987. NTIS, PC A16/MF A01. (NASA-CP—2475; E—3450; NAS—1.55:2475; CONF-8610165—).

From Space photovoltaic research and technology conference; Cleveland, OH, USA (7 Oct 1986).

The major requirements and guidelines that affect the space station configuration and power system are explained. The evolution of the space station power system from the NASA program development-feasibility phase through the current preliminary design phase is described. Several early station concepts are described and linked to the present concept. Trade study selections of photovoltaic system technologies are described in detail. A summary of present solar dynamic and power management and distribution systems is also given.

551 **PV system failures, test techniques, and analysis.** Risser, V.V.; Schaefer, J.C. (New Mexico Solar Energy Institute, Las Cruces, USA). pp 68-72 of Seventh E.C. photovoltaic solar energy conference. Goetzberger, A.; Palz, W.; Willeke, G. (eds.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1987). (CONF-861021—).

From 7. European photovoltaic solar energy conference; Sevilla, Spain (27 Oct 1986).

The New Mexico Solar Energy Institute has tested and evaluated many of the large flat-plate PV systems (20-1000 kW) in the United States over the past three years, some systems several times. The results provide data for determining component reliability, information on performance degradation, evaluation of test techniques, and guidance for future designs. The results, discussed in this paper, are encouraging. Techniques have been developed to test large PV systems and to isolate failures to a module level. Of the 64,000 modules tested, 362 modules, 0.5%, were not contributing power. The most frequent failures are connections between modules; however, switch problems disable more modules. 3 figs., 1 tab.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 548, 550

552 **(DOE/AL/16333—T1) Gas fired, solar augmented receiver: Final report, October 1985-July 1986.** Washom, B.J.; Ziph, B.; Godett, T.M.; Kearney, D. (Advanco Corp., Beverly Hills, CA (USA)). Jun 1987. Contract FC04-82AL16333. 214p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88000185/JAW.

Under this project, a design was developed for a gas combustor with a sodium heat pipe to be coupled with a high efficiency Stirling Power Conversion System for the cogeneration and solar market. The power application ranged between 25kWe for the solar case and 75 kWe for cogeneration. Extensive economic analysis was independently conducted to determine the performance and O and M requirements of the systems for the widest possible market penetration.

553 **(DOE/NASA/33408—2) Comparison of Stirling engines for use with a 25-kW dish-electric conversion system.** Shaltens, R.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. Contract AT04-85AL33408. 16p. (NASA-TM—100111; AIAA—87-9069; CONF-870804—36). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014499/JAW.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The Department of Energy's (DOE) Solar Thermal Technology Program, Sandia National Laboratories (SNLA), is evaluating heat engines for terrestrial solar distributed heat receivers. The Stirling engine has been identified by SNLA as one of the most promising engines for terrestrial applications. The potential to meet DOE's goals for performance and cost can be met by the free-piston Stirling engine. NASA Lewis is providing technical management for an Advanced Stirling Conversion System (ASCS) through a cooperative Interagency Agreement with DOE. Parallel contracts have been awarded to Mechanical Technology, Inc. (MIT) of Latham, New York, and Stirling Technology Company (STC) of Richland, Washington, for the conceptual designs of an ASCS. Each design will feature a free-piston Stirling engine, a liquid-metal heat pipe receiver, and a means to provide about 25 kW of electric power to a utility grid while meeting DOE's long-term performance and cost goals. The MTI design incorporates a linear alternator to directly convert the solar energy to electricity while STC generates electrical power indirectly by using a hydraulic output to a ground-based hydraulic pump/motor coupled to a rotating alternator. Both designs for the ASCS's will use technology which can reasonably be expected to be available in the 1980's. Both the MTI and STC concepts will be evaluated by the same, but independent, contractor to provide a manufacturing and cost analysis including life cycle cost. The ASCS designs using a free-piston Stirling engine, a heat transport system, a receiver, and the methods of providing electricity to the utility grid will be discussed.

554 **(N—87-25884, pp 45) High temperature electrolyzer/fuel cell power cycle: Preliminary design considerations.** Morehouse, J.H. Jun 1987. NTIS, PC A13/MF A01. (NASA-CR—171984-VOL-2; NAS—1.26:171984-VOL-2).

In National Aeronautics and Space Administration (NASA)/ American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, Volume 2.

A model of a high temperature electrolyzer/fuel cell, hydrogen/oxygen, thermally regenerative power cycle is developed and used to simulate system performance for varying system parameters. Initial estimates of system efficiency, weight, and volume are provided for a one KWe module assuming specific electrolyzer and fuel cell characteristics, both current and future. Specific interest is placed on examining the system responses to changes in device voltage versus current density operating curves, and the associated optimum operating ranges. The performance of a solar-powered, space based system in low earth orbit is examined in terms of the light-dark periods requiring storage. The storage design tradeoffs between thermal energy, electrical energy, and hydrogen/oxygen mass storage are examined. The current technology module is based on the 1000 C solid oxide electrolyzer cell and the alkaline fuel cell. The future technology system examines benefits involved with developing a 1800K electrolyzer operating with an advanced fuel cell.

555 **(PNL-SA—14588) Performance analysis of solar thermal power systems.** Williams, T.A.; Dirks, J.A. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 12p. (CONF-8707117—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000563/ JAW.

From Conference of the American Solar Energy Society; Boulder, CO, USA (12 Jul 1987).

This paper discusses appropriate methods of analyzing and predicting the performance of solar thermal power plants for electric applications, and provides insight into the major energy loss mechanisms for solar thermal systems. The efficiency of each component in a solar thermal plant is discussed as are the plant parasitic losses and plant availability. This is followed by a discussion of the computer simulation which is needed to derive reasonable projections of component annual efficiencies and parasitic losses. Finally, plant design considerations and annual system performance estimates are made.

556 **(SAND—86-8056) The developmental status of solar thermochemical hydrogen production.** Pretzel, C.W.; Funk, J.E. (Sandia National Labs., Livermore, CA (USA)). Sep 1987. Contract AC04-76DR00789. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001778/ JAW.

This report discusses the status of development on solar thermochemical hydrogen production. It discusses the results of recent experiments of components for the solar interface. Various process designs that have been proposed are examined and areas of technical concern are discussed. The process has the potential for having the highest efficiency for producing hydrogen from water. Development has consisted of process flowsheet designs for using nuclear heat sources, several solar interface conceptual designs, and experiments for solar central receiver components. Conceptually, the flowsheets show how the chemical process plant is to actually be built. Each stream is identified and temperature, pressure, and composition are specified. The function of each piece of process equipment - reactors, heat exchangers - is defined. Design requirements such as conversion, heat transfer, etc., and materials of construction are established. While many uncertainties still exist, we have identified no major technical problems that will prevent the production of solar thermochemical hydrogen if additional analysis and experimentation are completed. An economic assessment was performed by determining hydrogen product costs using realistic solar availability conditions. The conclusions list the major areas that need continuing work.

557 **(SAND—86-8058) Characteristics of current solar central receiver projects.** Baker, A.F.; Skinrood, A.C. (Sandia National Labs., Livermore, CA (USA)). Oct 1987. Contract AC04-76DR00789. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001314/JAW.

This report summarizes the characteristics and status of six experimental solar central receiver projects. These are Eurelios (located in Italy), CESA-I (Spain), International Energy Agency Small Solar Power Systems Project (Spain), Sunshine (Japan), Themis (France), and Solar One (US).

558 **(SAND—86-8185) Central receiver plant evaluation: (1) Insolation data from Odeillo and Targasonne.** Amri, A.; Izygon, M.; Tedjiza, B. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France); Sandia National Labs., Livermore, CA (USA)). Sep 1987. Contract AC04-76DR00789. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001583/JAW.

This report presents the meteorological data of interest for the evaluation of the THEMIS central receiver experimental plant and describes the meteorological measuring equipment of THEMIS. The direct insolation data recorded at THEMIS during 1984 are listed and analyzed. The Odeillo records of 1983 and 1984 are also presented for comparison. Finally the distributions of the daily insolation are established for Odeillo (1983 and 1984) and THEMIS (1984). These distributions are a basic tool for our evaluation of the yearly energy production of THEMIS.

559 **(SAND—87-8021) International Energy Agency (IEA) Small Solar Power Systems (SSPS) sodium cavity and external receiver performance comparison.** Baker, A.F. (Sandia National Labs., Livermore, CA (USA)). Oct 1987. Contract AC04-76DR00789. 43p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88001310/JAW.

This report uses experimental data to compare the performance of two sodium cooled solar central receivers operated at the International Energy Agency Small Solar Power Systems project near Almeria, Spain. Performance includes point-in-time steady state efficiency, average efficiency, start-up time, and operation time. Point-in-time steady state efficiency calculations were based on the statistical method of least squares using receiver incident and absorbed powers. One receiver, a cavity type, showed a peak steady state receiver efficiency of 87% +- 5% and an average efficiency of about 67%. The other receiver, an external "billboard" type, had a peak steady state receiver efficiency of 96% +- 4% and an average efficiency of about 79%. The original design peak steady state efficiency predictions for both receivers were within the experimentally determined 95% probability interval. Thermal loss test data were evaluated for the external receiver to confirm its point-in-time steady state efficiency independent of the receiver incident power. The thermal loss, which includes emitted radiation, convection, and conduction from the external receiver, was less

than 100 kW/sub t/ with the receiver operating at normal design conditions and having an absorbed power of over 2200 kW/sub t/.

560 **(SAND—87-8226) 10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant mirror module corrosion torque tube damage and vent tube assessment survey, July 1985 and July 1986.** Danzo, M.A.; Velazquez, R.L.; Mavis, C.L. (Sandia National Labs., Livermore, CA (USA); Southern California Edison Co., Rosemead (USA)). Sep 1987. Contract AC04-76DR00789. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000913/JAW.

This report documents the results of the July 1985 and July 1986 surveys of mirror module corrosion and torque tube damage at the 10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant. It also assesses the effect of vent tubes on the corrosion growth rate. Results show that 0.052% and 0.061% of the total reflective area of the heliostat field was corroded in 1985 and 1986, respectively. However, the corrosion growth rate is much less than in previous years, primarily because of the effect of mirror module vent tubes. In the July 1984 survey, 35 torque tubes were damaged due to impact with the gear box. The 1985 survey showed that 14 of those same torque tubes were re-damaged. In addition, 9 newly dented ones were found. In the July 1986 survey, 39 torque tubes were dented, of which 4 were redented from 1985. The denting is caused when the gear-drive travels past the limit switch due to a shorted diode in parallel with the limit switch.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 567, 1042

561 **(AD-A—183171/8/XAB) Reactor experiments at the University of Minnesota. Technical report.** Fletcher, E.A. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). 15 Jul 1987. 12p. (TR—9). NTIS, PC A02/MF A01.

Reactors are described and operating experience achieved with them in a 4.2-m solar furnace are reported. Water spitting, recovery of hydrogen and sulfur from hydrogen sulfide, electrolysis of zinc oxide in vapor and liquid phases, oil recovery from shale, and fixing atmospheric nitrogen, are discussed.

562 **(LA-UR—87-2135) Transient development of stratification in a partially divided enclosure.** Otis, D.R.; Jones, G.F. (University of Petroleum and Minerals, Dhahran (Saudi Arabia); Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-871207—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87011742/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

In passive solar heating of buildings or in compartment fires, we are concerned with the development of thermal stratification when two rooms at different temperatures are connected by the opening of a door. We have performed experiments and numerical calculations aimed at this application. The experiments consists of flow visualization and temperature measurements obtained when isolated halves of a tank containing water at two different temperatures are suddenly connected to allow flow between the zones. Two significant findings from this work are: (1) the presence of internal waves excited by the onset of flow through the doorway which have not normally been observed in past laboratory experiments, and (2) the equilibration time is found to be in general agreement with that predicted by a formula from a simple orifice model that we describe. Work is progressing on numerical simulations using two core stratification models connected by an orifice including entrainment in the neighborhood of the connection. 27 refs., 5 figs., 1 tab.

563 **(TNO-TPD—627.021) Test conditions for solar water heaters.** Visser, H. (Nijverheidsorganisatie TNO, Delft (Netherlands). Technisch Physische Dienst). Feb 1987. 57p. (In Dutch). Technisch Physische Dienst TNO-TH, P.O. Box 155, 2600 AD Delft, Netherlands.

The efficiency of solar water heaters depends on the tap pattern, temperature of the surrounding air, and, of course the supply of sunshine. Test conditions include a fixed tap pattern and a fixed testing period of 10 days in a row.

564 **Effects of daylighting options on the energy performance of two existing passive commercial buildings.** Andersson, B.; Kammerud, R.; Albrand, P.; Adegran, M.; Webster, T.; Place, W. (Lawrence Berkeley Lab., CA, USA; Calthorpe Associates, Sausalito, CA, US; Energy-Line, Hayward, CA, US; Carolina State Univ., Raleigh, NC, US. Dept. of Architecture). *Building and Environment;* 22: No. 1, 3-12(1987).

Results are presented from a study of south facing roof apertures on two buildings from the U.S. Department of Energy's Non-Residential Experimental Passive Buildings Program. Results reported provide quantitative information on the energy benefits of the daylighting systems as designed and used in the two buildings examined. The daylighting strategies are shown to provide substantial energy savings over similar non-daylit buildings. In both buildings, manual control of the electric lights is used; the evaluation demonstrates that in these buildings this proves to be an extremely effective strategy. Factors contributing to this result are discussed in terms of the observed behavior of the occupants and functional requirements of the buildings.

565 **Effects of occupant issues on the energy performance of two existing passive commercial buildings.** Andersson, B.; Albrand, P.; Kammerud, R.; Kantrowitz, M.; Webster, T.; Adegran, M. (Lawrence Berkeley Lab., CA, USA; Kantrowitz, Min and Associates, Inc., Albuquerque, NM, USA; Energy-Line, Hayward, CA, US; Calthorpe Associates, Sausalito, CA, US). *Building and Environment;* 22: No. 1, 13-48(1987).

Results are presented from a study of occupant related energy issues in two buildings from the U.S. Department of Energy's Passive Non-Residential Experimental Buildings Program. Results reported provide quantitative information on energy impacts of building modifications that affect or are affected by occupant satisfaction and interaction with passive systems in the two buildings examined. Passive strategies are shown to affect the occupants' environment as well as the buildings' energy use. Two distinct techniques for utilizing thermal mass in passive commercial buildings are identified and characterized. Changes to thermostat control strategy and solar aperture shading are shown to be capable of causing significant changes in building energy performance and occupant comfort. Effective acoustic treatments which can be designed to have only marginal effects on energy requirements and occupant comfort are described.

566 **Absorption machine irreversibility using new entropy calculations.** Anand, D.K.; Kumar, B. (Univ. of Maryland, College Park). *Solar Energy;* 39: No. 3, 243-256(1987). Contract AC03-79CS30204.

This paper is concerned with the calculation of LiBr/H_2O properties over the complete range of useful temperatures and concentrations applicable to the absorption cycle. This information is then used to calculate individual irreversibilities for all the components of single and double effect LiBr/H_2O absorption cycles. In order to calculate the value of the specific entropy of aqueous LiBr, it is necessary to first calculate the enthalpy values. In addition, the activity coefficient of the salt for all concentrations at a given temperature must be known. The activity coefficient is not independent of the P-T-x data and can be obtained from it by carrying out the numerical integration of the Gibbs-Duhem equation. For consistency, in the calculation of entropy, it is necessary that the same P-T-x data be used both for the calculation of the enthalpy values, as well as to obtain the activity coefficient. The authors have consistently used the P-T-x data from Duhring equations to calculate the values of all thermodynamic properties. The values of the LiBr activity coefficients reported earlier and those calculated by the authors are very close to each other, but there is a systematic difference in that the calculated values are higher. Although the difference is small, it can still add up during the process of numerical integration which is essential to calculate the specific entropy over a range of concentrations. Consequently, a systematically

higher value of solution entropy is reported. However, the trend of entropy curves is quite similar to earlier results.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 494

567 **(PB—87-206819/XAB) Development of an innovative, low-cost solar collector. Final report, 30 January 1986-30 April 1987.** Squires, M.P. (Squires Labs., Las Cruces, NM (USA). American Solar Products Div.). Jun 1987. 80p. NTIS, PC A05/MF A01.

The goal of the contract was to develop and produce a Low Cost Domestic Water Heating System, one that could be sold at a retail price of $500. The primary effort was to reduce solar-collector costs and, more specifically, the collector absorber-plate costs. Plastic-adhesive research, under this contract, resulted in the extensive use of silicone adhesives in a high-performance solar collector which was also durable, reliable, and easy to manufacture at a low cost. High thermal performance resulted from development of a silicone-based conductive bond. The new collector has full-pressure capability (150psi Test, 100psi Working), and can be manufactured in quantity at a materials cost of $55 and a labor cost of $3.35. The report includes detailed design descriptions, drawings, and photographs of four different low-cost solar collectors designed and built under the contract. Also, material listings and a step-by-step procedure for manufacturing the selected collector are included. NMSEI Performance Data for the new collector are compared to the certification data of the model SL-100 collector previously manufactured by American Solar Products.

568 **New simplified version of the Perez diffuse irradiance model for tilted surfaces.** Perez, R.; Seals, R.; Ineichen, P.; Stewart, R.; Menicucci, D. (SUNY, Albany, NY). *Solar Energy;* 39: No. 3, 221-231(1987).

A new, more accurate and considerably simpler version of the Perez[1] diffuse irradiance model is presented. This model is one of those used currently to estimate short time step (hourly or less) irradiance on tilted planes based on global and direct (or diffuse) irradiance. It has been shown to perform more accurately than other models for a large number of locations worldwide. The key assumptions defining the model remain basically unchanged. These include (1) a description of the sky dome featuring a circumsolar zone and horizon zone superimposed over an isotropic background, (2) a parameterization of insolation conditions (based on available inputs to the model), determining the value of the radiant power originating from these two zones. Operational modifications performed on the model are presented in a step by step approach. Each change is justified on the basis of increased ease of use and/or overall accuracy. Two years of hourly data on tilted planes from two climatically distinct sites in France are used to verify performance accuracy. The isotropic, Hay and Klucher models are used as reference. Major changes include (1) the simplification of the governing equation by use of reduced brightness coefficients; (2) the allowance for negative coefficients; (3) reduction of the horizon band to an arc-of-great-circle; (4) optimization of the circumsolar region width; and (5) optimization of insolation conditions parameterization.

569 **Major design, and operational considerations of salt-gradient solar ponds.** Hull, J.R.; Cha, Y.S.; Sha, W.T. (Argonne National Lab., Argonne, IL). pp 1-15 of Proceedings of the 2nd national conference on renewable energy technologies. San Juan, PR; Center for Energy and Environmental Research (1983). (CONF-8308231—).

From 1. Pan American conference on energy and 2nd national conference on renewable energy technologies; San Juan, Puerto Rico (1 Aug 1983).

A salt-gradient solar pond is a body of water containing a salt gradient in the upper part of the pond, such that salinity increases with depth. Sunlight is absorbed throughout the pond and especially on the pond bottom, raising the water temperature. Without the salt gradient the heated water at the pond bottom, finding itself less dense than the cooler water above it, would rise to the surface, where the heat would be lost. This article will discuss information discovered since previous reviews were written. The major considerations necessary for using salt-gradient solar ponds are discussed, based on the experience gained in the design, construction, and operation of the 1000 m/sup 2/ Research Salt Gradient Solar Pond (RSGSP) at Argonne National Laboratory (ANL). A salinity profile and temperature profile from the ANL RSGSP are shown.

1420 Heat Storage

570 **(ORNL/TM—10210) A study of the optimal transition temperature of PCM [phase change material] wallboard for solar energy storage.** Drake, J.B. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001522/JAW.

In this report, we consider the performance of wallboard impregnated with phase change material. An ideal setting is assumed and several measures of performance discussed. With a definition of optimal performance given, the performance with respect to variation of transition temperature is studied. Results are based on computer simulations of PCM wallboard with a standard stud wall construction. We find the diurnal heat capacity to be overly sensitive to numerical errors for use in PCM applications. The other measures of performance, diurnal effectiveness, net collected to storage ratio, and absolute discharge flux, all indicate similar trends. It is shown that the optimal transition temperature of the PCM is strongly influenced by amount of solar flux absorbed by the PCM. 6 refs., 5 figs., 5 tabs.

571 **Durability of latent heat storage tube-sheets.** Ting, K.C.; Giannakakos, P.N.; Gilbert, S.G. (Rutgers, The State Univ. of New Jersey, New Brunswick). *Solar Energy;* 39: No. 2, 79-85(1987).

Compatibility and durability of phase change materials (PCM) and packaging laminate films were tested in this study. The objective was to identify viable component materials for heat storage tube-sheets. The tube-sheets are the essential part of a patented latent heat storage device. The unique feature of the device is its offset arrangement of mass-producible units. The results of cycling tests on two PCMs and one laminate are presented in this paper. After more than 1000 accelerated cycles of charging and discharging tests, the tubes maintained operable stability and showed no sign of deterioration. The PCMs displayed the same temperature-time pattern during the entire cycling test. The packaging laminate was compatible with the PCM's and capable of maintaining satisfactory strength.

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 1994

572 **(DOE/SF/12326—T1) Listing of United States companies that supply goods and services for geothermal explorers, developers and producers internationally.** (Geothermal Resources Council, Davis, CA (USA)). Aug 1987. Contract AH03-86SF12326. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000287/JAW.

This List is composed solely of US companies with major offices within the United States. All of the companies listed are involved in selling geothermally related goods and services internationally, or have the proven capability to do so. Each specific listing includes the company name, the name or title of the key contact person, address, telephone and if available a facsimile machine or telex number.

573 **(EPRI-AP—4259-SR-Vol.1) Proceedings: Ninth annual geothermal and second IIE-EPRI geothermal conference and workshop: Volume 1, Spanish version: Special report.** (Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 446p. (In Spanish). (CONF-8506369—Vol.1). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920016/JAW.

From 9. annual geothermal and second IIE-EPRI geothermal conference and workshop; San Diego, CA, USA (25 Jun 1985).

This volume contains proceedings, the theme of which was "Enhancing Geothermal Development through Information Exchange." Technical sessions included a review of geothermal power plant experience, presentations on reservoir research, discussions on geothermal power plant development, results from research projects, and overviews of the EPRI geothermal program. A panel discussion presented varied perspectives on the available geothermal information and an update on international geothermal activity was given.

574 **(EPRI-AP—4259-SR-Vol.2) Proceedings: Ninth annual geothermal and second IIE-EPRI geothermal conference and workshop: Volume 2, English version: Special report.** (Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 511p. (CONF-8506369—Vol.2). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920017/JAW.

From 9. annual geothermal and second IIE-EPRI geothermal conference and workshop; San Diego, CA, USA (25 Jun 1985).

This volume contains proceedings, the theme of which was "Enhancing Geothermal Development through Information Exchange." Technical sessions included a review of geothermal power plant experience, presentations on reservoir research, discussions on geothermal power plant development, results from research projects, and overviews of the EPRI geothermal program. A panel discussion presented varied perspectives on the available geothermal information and an update on international geothermal activity was given. Separate abstracts were prepared for individual papers.

575 **(UCRL—97181) Geothermal programs at Lawrence Livermore National Laboratory.** Kasameyer, P.W.; Younker, L.W. (Lawrence Livermore National Lab., CA (USA)). 10 Jul 1987. Contract W-7405-ENG-48. 8p. (CONF-871024—18). NTIS, PC A02. Order Number DE87013802/JAW.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

Lawrence Livermore National Laboratory has a number of geothermal programs supported through two offices in the Department of Energy: the Office of Renewable Technologies, Geothermal Technologies Division, and the Office of Basic Energy Sciences, Division of Engineering, Mathematics and Geosciences. Within these programs, we are carrying out research in injection monitoring, optical instrumentation for geothermal wells, seismic imaging methods, geophysical and drilling investigations of young volcanic systems in California, and fundamental studies of the rock and mineral properties.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 589

576 (CONF-8208109—Vol.2, pp 661-681) **Model of the heat source of the Cerro Prieto magma-hydrothermal system, Baja California, Mexico.** Elders, W.A.; Bird, D.K.; Williams, A.E.; Schiffman, P.; Cox, B. (Univ. of California, Riverside). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

Earlier studies at Cerro Prieto by UCR have led to the development of a qualitative model for field flow in the geothermal system before it was drilled and perturbed by production. Current efforts are directed towards numerical modelling of heat and mass transfer in the system in this undisturbed state. A two-dimensional model assumes that the heat sources were a single basalt/gabbro intrusion which provided heat to the system as it cooled. After compiling various information on the physical properties of the reservoir, the enthalpy contained in two 1cm thick section across the reservoir orthogonal to each other was calculated. Next various shapes, sizes and depths for the intrusion as initial conditions and boundary conditions for the calculation of heat transfer were considered. A family of numerical models which so far gives the best matches to the conditions observed in the field today have in common a funnel-shaped intrusion with a top 4km wide emplaced at a depth of 5km some 30,000 to 50,000 years ago, providing heat to the geothermal system. Numerical modelling is still in progress. Although none of the models so far computed may be a perfect match for the thermal history of the reservoir, they all indicate that the intrusive heat source is young, close and large.

577 (CONF-8208109—Vol.2, pp 763-782) **Analysis of exploratory wells in the Cerro Prieto Field and the Mexicali Valley.** Cobo R., J.M.; Bermejo M., F.J. 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

Agricultural development in the Mexicali Valley and in the high cost of electric power required to operate the irrigation wells in the Valley prompted the Mexican government to investigate the possibility of taking advantage of thermal manifestations in the area located 28 km southeast of the city of Mexicali to generate electric power and thereby partially decrease the flight of foreign exchange. In 1958, a geologic study of the southern and southeastern zone of Mexicali was conducted to identify the possibilities of tapping geothermal resources. The purpose of this study was to gain knowledge of the geologic conditions in this area and, if possible, to establish the location of exploratory and production wells and, on the basis of the results of the former, examine the geologic history in order to gain knowledge and understanding of the structural control of the steam. On the basis of this study, it was recommended that 3 exploratory wells should be drilled in order to locate weak zones that would easily allow for steam flow.

578 (CONF-8208109—Vol.2, pp 807-814) **Microfossils from Cerro Prieto geothermal wells, Baja California, Mexico.** Cotton, M.L.; Haar, S.V. (Univ. of Southern California, Los Angeles). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

To aid in a paleonenvironmental and age reconstruction of the Cerro Prieto reservoir system, 59 samples of well cuttings were analyzed for microfossils. The cuttings were obtained at depths from 351 to 3495m in 14 geothermal wells in the Cerro Prieto field, Baja California, Mexico. Foraminifera was found in 6 samples, ostracodes in 19 samples and mannoplankton as coccoliths in 24 samples. Other groups, such as molluscus, insects, fish skeletal parts, and plant material were occasionally present. Detailed interpretations at this time cannot be made because of poor preservation of samples. This is primarily due to causes: dissolution by geothermal fluids that reach 350°C, and the extensive mixing of filled Cretaceous forms (reworked from the Colorado Plateau region) with Tertiary species during drilling. Further studies of ostracodes and foraminifera from colder portions of the wells are needed. The abundant and well-preserved ostracodes indicate marine to backish water inviroments that correspond in part, to lagoonal or estuarine facies. The presence of the mid-Tertiary (15-m.y.-old) marine foraminifera, Cassigerinela chipolensis, in wells M-11 and M-38, 350 to 500m deep, is perplexing. These are not laboratory contaminates and, as yet have not been found in the drilling mud. If further studies confirm their presence at Cerro Prieto, established ideas about the opening of the Gulf of California and about Pacific Coast mid-Tertiary history will need to be rewritten.

579 **(LBL—23888) Interpretation of shallow crustal structure of the Imperial Valley, California, from seismic reflection profiles.** Severson, L.K. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000472/JAW.

Eight seismic reflection profiles (285 km total length) from the Imperial Valley, California, were provided to CALCRUST for reprocessing and interpretation. Two profiles were located along the western margin of the valley, five profiles were situated along the eastern margin and one traversed the deepest portion of the basin. These data reveal that the central basin contains a wedge of highly faulted sediments that thins to the east. Most of the faulting is strike-slip but there is evidence for block rotations on the scale of 5 to 10 kilometers within the Brawley Seismic Zone. These lines provide insight into the nature of the east and west edges of the Imperial Valley. The basement at the northwestern margin of the

valley, to the north of the Superstition Hills, has been normal-faulted and blocks of basement material have "calved" into the trough. A blanket of sediments has been deposited on this margin. To the south of the Superstition Hills and Superstition Mountain, the top of the basement is a detachment surface that dips gently into the basin. This margin is also covered by a thick sequence sediments. The basement of the eastern margin consists of metamorphic rocks of the upper plate of the Chocolate Mountain Thrust system underlain by the Orocopia Schist. These rocks dip to the southeast and extend westward to the Sand Hills Fault but do not appear to cross it. Thus, the Sand Hills Fault is interpreted to be the southern extension of the San Andreas Fault. North of the Sand Hills Fault the East Highline Canal seismicity lineament is associated with a strike-slip fault and is probably linked to the Sand Hills Fault. Six geothermal areas crossed by these lines, in agreement with previous studies of geothermal reservoirs, are associated with "faded" zones, Bouguer gravity and heat flow maxima, and with higher seismic velocities than surrounding terranes.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 576, 577, 578

580 (CONF-8208109—Vol.2, pp 463-468) **Vapor flow into the feeding zone of Cerro Prieto I wells.** Nieva, D.; Fausto, J.; Gonzalez, J.; Garibaldi, Y.F. 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

The fraction of vapor present in the fluid feeding zone of several of the wells of Cerro Prieto I has been estimated through the consideration of down-hole temperatures and specific enthalpies of produce mixture. In addition, by considering the composition of the vapor phase, the contribution of the flow of vapor generated elsewhere into the feeding zone of each of those wells has been calculated.

581 (CONF-8208109—Vol.2, pp 469-478) **Relationship of radon concentration to spacial and temporal variations of reservoir thermodynamic conditions in the Cerro Prieto Geothermal Field.** Semprini, L.; Kruger, P. (Stanford Univ., CA). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

Measurements of radon concentration in produced fluids in Cerro Prieto are evaluated with respect to spacial and temporal variations in reservoir thermodynamic conditions and the rock mass to fluid mass ratio emanation. Observed higher concentration of radon at wells with higher fluid enthalpy can be attributed to the higher steam fraction in the wellhead fluid. Correlations of radon concentration to specific volume of pore fluid leads to improved correlations coefficients. The improvement results from the dependence of specific volume on both enthalpy and reservoir temperature. Temporal variations in radon concentration reflect changing phase conditions in the reservoir. Observations over a 2-year interval show significant changes in the producing zones. For example, the constant, low concentration along the western edge of the field indicates a fluid of low steam saturation. In the eastern area, radon concentrations have increased significantly suggesting an increase in the steam saturation in this part of the reservoir due to exploitation. Other areas, e.g., the southeast area, show decreased radon concentration, indicating a decrease in the vapor content of the field. Concurrent measurements of ammonia, a soluble component of the noncondensable gases, support the observation of partitioning of gas components, with wellhead concentration dependent on spacial variations in steam saturation over the field.

582 (CONF-8208109—Vol.2, pp 487-494) **Review of progress in understanding the fluid geochemistry of the Cerro Prieto Geothermal System.** Truesdell, A.H.; Nehring, N.L.; Thompson, J.M.; Janik, C.J.; Coplen, T.B. (Geological Survey, Menlo Park, CA). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

Fluid geochemistry has played a major role in the authors present understanding of the Cerro Prieto geothermal system. Fluid chemical and isotopic compositions have been used to indicate the origin of water, salts, and gases, original subsurface temperature and fluid flow, fluid-production mechanims, and production-induced aquifer boiling and cold-water entry. The extensive geochemical data and interpretation for Cerro Prieto published from 1964 to 1981 are reviewed and discussed. Fluid geochemistry must continue to play an important role in the further development of the Cerro Prieto field.

583 (CONF-8208109—Vol.2, pp 501-508) **Hydrocarbon production in the Cerro Prieto Geothermal Field.** Des Marais, D.J.; Stallard, M.L.; Nehring, N.L.; Truesdell, A.H. (Ames Research Center, Moffett Field, CA). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

Hydrocarbon abundance and stable carbon isotopic compositions were measured in wells M-5, M-26, M-35 and M-102, which represent a range of depths (1270 to 2000m) and temperatures (275 to 330°C) in the field. Parallel measurements were made on gases from the laboratory pyrolysis of coal (Prian 1 well depth = 1860m), in an attempt to simulate the production of the geothermal hydrocarbons. In both the well and laboratory observations, high temperature environments favored higher relative concentrations of methane, ethane and benzene and generally higher $^{13}C/^{12}C$ values in the individual hydrocarbons. The best correlation between the laboratory and well data is obtained when laboratory-produced gases from experiments conducted at lower (400°C) and higher (600°C) temperatures are mixed. This improved correlation suggests that the wells are sampling hydrocarbons produced from a spectrum of depths and temperatures in the sediments.

584 (CONF-8208109—Vol.2, pp 515-520) **Chemical equilibria in the Cerro Prieto hydrothermal fluid.** Henley, R.W. (Geological Survey, Menlo Park, CA). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

The Cerro Prieto hydrothermal fluid is in chemical equilibrium with detrital and alteration minerals in the deltaic sediments of the Colorado River that make up its reservoir. Reservoir conditions span 240 to 330°C and extensive analyses have been made of waters and gases covering the entire temperature range. Calculations using the downhole chemistry program ENTHALP have been made of aquifer pH and ion activities. This data and calculations of gas pressures and concentrations have been used to calculate saturation equilibria with minerals in the aquifer. Although further refinements to the computer program and to the thermodynamic data may be necessary for the high temperature and salinity of the fluid, calculations show that equilibrium at or somewhat above aquifer temperature is found with K spar, Na spar, high Na plagioclase, calcite, anhydrite, pyrite, pyrrhotite, graphite (coal) and possibly magnetite. The dissolved gases CO_2, H_2S, H_2, N_2 and NH_3 are in equilibrium with each other although CH_4 equilibria are apparently frozen in at temperatures somewhat above those of the reservoir.

585 (CONF-8208109—Vol.2, pp 525-530) **Gas reaction in the Cerro Prieto reservoir.** Nehring, N.L.; Valette-Silver, J.N. (Geological Survey, Menlo Park, CA). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

Gases in an undisturbed geothermal reservoir should be in equilibrium with the surrounding rock and water. Production of fluid at rapid rates may cause physical changes in the reservoir that are reflected as changes in gas composition. At Cerro Prieto production has lowered the reservoir pressure enough in places to induce boiling in the aquifer, leading to high enthalpy, low production and eventual drawndown of cold water into the reservoir. These changes are reflected in gas compositions. Differences, in gas composition between well and surface samples reflect changing

equilibrium in temperature-dependent chemical reactions and a mixture of gases dissolved in groundwater.

586 (CONF-8208109—Vol.2, pp 535-541) **Carbon-13 variations in fluids from the Cerro Prieto geothermal system.** Janik, C.J.; Nehring, N.L.; Huebner, M.A.; Truesdell, A.H. (Geological Survey, Menlo Park, CA). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

The carbon isotope compositions of CO_2 in steam from Cerro Prieto production well have been measured for 1977, 1979, and 1982. Variations in the $\delta^{13}C$ values are caused by production-related changes in the chemical and physical parameters of the geothermal system. In 1977, most CO_2 in the reservoir was isotopically light ($\delta^{13}C = -6.4 +/- 0.4$). Heavier CO_2 was produced from wells in the center of the field (M5,M26,M27) due to deposition of isotopically light calcite caused by near-well boiling. In 1979 nearly all well showed relatively heavy CO_2, probably due to expansion of aquifer boiling and calcite precipitation. In 1982, many wells in the central part of the field were shut in. The amount of drawndown decreased and as temperatures and pressures near the wells increased, the boiling zones collapsed. The CO_2 in the fluid then exchanged with the precipitated calcite and became isotopically lighter. The sensitivity of carbon isotopes to calcite precipitations caused by aquifer boiling and to reequilibration with this deposited calcite upon decrease of boiling suggests use as an indicator of these aquifer processes. Surficial CO_2 of thermal origin was collected in 1981. Generally, the carbon-13 contents were close to CO_2 from production wells except for high-temperature mud pots and fumaroles containing isotopically light CO_2 derived from near surface alteration of organic matter.

587 (CONF-8208109—Vol.2, pp 547-548) **Trace element and isotopic chemistry of the surficial hydrothermal waters in the Cerro Prieto, Geothermal Field, Mexico.** Valette-Silver, J.N.; Ganje, T.J.; Bradford, G.R.; Coplen, T. (Universite de Perpignan, France). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

In the Cerro Prieto Geothermal Field, five kinds of surface emissions were discovered in spring, mud pot, geysers, fumarole, and cool pool. The major element composition of the 163 fluid samples collected in 1979, was previously performed. This study was recently completed by a determination of trace element concentrations, deuterium and oxygen isotope ratios. This geochemical analysis shows, as the major elements do, that each type of surficial emission is characterized by its own unique chemistry. Each category of surface emission appears to result from different processes; trace chemistry as well as isotope composition confirm the various origins of the different surface hydrothermal fluids.

588 (CONF-8208109—Vol.2, pp 571-581) **Stable isotope systematics of oxygen and carbon in and around the Cerro Prieto geothermal anomaly, Baja California, Mexico.** Williams, A.E. (Univ. of California, Riverside). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

Rock samples from a total of 50 drillholes in the Cerro Prieto geothermal area have been analyzed by stable isotopic techniques. In particular, calcite in cuttings and core samples from these wells have been analyzed to observe systematic variation in carbon ($\delta^{13}C$) and oxygen ($\delta^{18}O$) isotopic compositions. Consistent behaviors of these isotopic systems were observed and provide a large amount of information on the processes of calcite-water isotopic equilibration, dissolution-precipitation and descarbonation occurring within and around the reservoir. Oxygen isotopic equilibration of calcite and the geothermal fluid provides a useful indicator of the variations of temperature throughout the area before the drilling of geothermal wells. Data on several additional wells drilled into previously unexplored areas and depth intervals have been accumulated to permit clarification of details in the three-dimensional picture of the Cerro Prieto thermal anomaly. Long-term natural flow directions within the geothermal system can often be inferred directly from the three-dimensional distribution of temperatures within the field. Within the geothermal reservoir, a gradual disappearance of calcite, with increasing temperature, correlates generally with a slight decrease in $\delta^{13}C$ of the calcite. Although this pattern is nearly identical to the isotopic changes occurring during descarbonation of calcite in skarn areas, it is probable that other processes involving dissolution by the brines or isotopic exchange with an external carbon reservoir are also locally important.

589 (CONF-8208109—Vol.2, pp 783-798) **Fluid flow model of the Cerro Prieto Geothermal Field based on well log interpretation.** Halfman, S.E.; Lippmann, M.J.; Zelwe, R.; Howard, J.H. 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

The subsurface geology of the Cerro Prieto geothermal field was analyzed using geophysical and lithologic logs. The distribution of permeable and relatively impermeable units and the location of faults are shown in a geologic model of the system. By incorporating well completion data and downhole temperature profiles into the geologic model, it was possible to determine the direction of geothermal fluid flow and the role of subsurface geologic features that control this movement.

1508 Geothermal Power Plants

590 (EGG-M—38886) **Geothermal heat cycle research: Supercritical cycle with horizontal counterflow condenser.** Mines, G.L.; Swank, W.D.; Bliem, C.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 6p. (CONF-870804—42). NTIS, PC A02. Order Number DE87014878/JAW.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

The Heat Cycle Research Program, which is being conducted for the Department of Energy, has as its objective the development of the technology for effecting the improved utilization of moderate temperature geothermal resources. To meet this objective, the program has as one of its goals to improve the performance of geothermal binary cycles to levels approaching the practicable thermodynamic maximum. In pursuit of this goal, tests are being conducted at the Heat Cycle Research Facility located at the DOE Geothermal Test Facility, East Mesa, California. The current testing involves the investigation of binary power cycle performance utilizing mixtures of non-adjacent hydrocarbons as the working fluids, with supercritical vaporization and in-tube condensation of the working fluid. In addition to the present test program, preparations are being made to investigate the binary cycle performance improvements which can be achieved by allowing supersaturated vapor expansions in the turbine. These efforts are anticipated to verify that through the utilization of these advanced power cycle concepts and allowing the supersaturated turbine expansions, improvements of up to 28% in the net geofluid effectiveness (net watt hours plant output per pound of geofluid) over conventional binary power plants can be achieved. Results are presented for the recent testing including those tests examining the performance of the countercurrent condenser at different tube inclinations. Performance of the heaters and the condenser in a vertical orientation can be predicted well with existing methods and data. The condenser in its near horizontal orientation performs slightly worse than in its vertical orientation. Some problems have been encountered in predicting the performance in the horizontal orientation. There is no evidence of departure from integral condensation in either orientation.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 580, 581, 582, 583, 584, 585, 586, 587, 588

591 (CONF-8208109—Vol.2, pp 551-562) **Geochemical evolution of Mexicali Valley groundwaters.** Makdisi, R.S.; Truesdell, A.H.; Thompson, J.M.; Coplen, T.B.; Sanchez R., J. (Geological Survey, Menlo Park, CA). 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

Isotopic and chemical compositions of Mexicali Valley groundwaters vary widely. Observed variations reflect different water origins, mineral-water reactions, lateral variations of delta facies as well as evaporation. Regional treatment of the groundwater data shows that northern and central regions are a mixture of old and new Colorado River water. Variations in water chemistry result from different groundwaters origins and the effects of lateral delta facies changes. Dissolution of gypsum and precipitation of carbonates, silicates, and phosphates are suggested. The eastern Mesa de San Luis and southern region water originates primarily from the Gila River catchment area. This water is undersaturated with respect to gypsum and carbonates and is oversaturated with respect to silicates. Most of the western groundwaters are a mixture of Colorado River and geothermal waters in the proximity of the Cerro Prieto geothermal field. Recharge to the geothermal aquifer is from the west as well as the north and east. Calcite is being precipitated out as the groundwater temperatures rise in response to the geothermal anomaly. Other western groundwaters reflect a dominant mixture of Colorado River water and evaporated lake water. Some Western groundwater samples suggest dilution by local rainwater and/or irrigation water.

592 (CONF-8208109—Vol.2, pp 609-616) **Geothermal drilling in Cerro Prieto.** Dominguez A., Bernardo. 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

The number of characteristics of the different wells that have been drilled in the Cerro Prieto geothermal field to date enable one to summarize the basic factors in the applied technology, draw some conclusions, improve systems and procedures, and define some problems that have not yet been satisfactorily solved, although the existing solution is the best now available. For all practical purposes, the 100 wells drilled in the three areas or blocks into which the Cerro Prieto field has been divided have been completed. Both exploratory and production wells have been drilled; problems of partial or total lack of control have made it necessary to abandon some of these wells, since they were unsafe to keep in production or even to be used for observation and/or study. The wells and their type, the type of constructed wells and the accumulative meters that have been drilled for such wells are summarized.

593 (CONF-8208109—Vol.2, pp 631-636) **Criteria for determining casing depth in Cerro Prieto.** Olivas M., H.M.; Vaca S., J.M.E. 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

On the basis of geological data obtained during drilling and its relation to electric logs, together with the problems that arose when drilling through formations until the production zone was reached, it is possible to establish the most suitable manner to line a well and thus formulate an optimum casings program. The main criteria to be taken into consideration in preparing such a program and its application in the drilling of wells programmed in Cerro Prieto to optimize and economize such drilling and achieve suitable techniques for well completion are presented. The criteria are based on the characteristics of the Cerro Prieto field and on casing design factors, as well as a experience gained during drilling in such a field.

594 (CONF-8208109—Vol.2, pp 655-659) **Geothermal well drilling manual at Cerro Prieto.** Fernandez P., A.; Flores S., M. 1982. NTIS, PC A18/MF A01. Order Number DE87003674/JAW.

From 4. symposium on the Cerro Prieto geothermal field; Guadalajara, Mexico (10 Aug 1982).

The objective of the drilling manual is to solve all problems directly related to drilling during the construction of a well. In this case, the topics dealt which are drilling fluids and hydraulics to be applied in the field to improve drilling progress, eliminate risks and achieve good well-completion. There are other topics that are applicable such as drill bits and the drilling string, which are closely linked to drilling progress. On this occasion drilling fluid and hydraulics programs are presented, in addition to a computing program for a Casio FX-502P calculator to be applied in the field to optimize hydraulics and in the analysis of hydraulics for development and exploration wells at their different intervals.

595 **(LBL—23718) Analysis of pressure, enthalpy and CO_2 transients in well BR21, Ohaaki, New Zealand.** Gaulke, S.W.; Bodvarsson, G.S. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 7p. (CONF-871024—19). NTIS, PC A02. Order Number DE87014675/JAW.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

Numerical studies are undertaken, which incorporate both double porosity and noncondensible gas effects, to determine the characteristics of the reservoir near well BR21 of Ohaaki geothermal field, New Zealand. It is shown that the application of numerical techniques to analyze two-phase well data can provide valuable information that may not otherwise be obtained. Numerical techniques allow more of the true reservoir complexities to be included, further constraining the results. The model developed adequately matches observed pressure, enthalpy and flowing CO_2 mass fraction while providing estimates of important reservoir parameters.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 211

17 WIND ENERGY

1703 Regulations

REFER ALSO TO CITATION(S) 598

1704 Economics

596 **(ECN-PB—87-3) The application of wind energy at the waste water purification plant at Goedereede, Netherlands.** Curvers, A.; Schuurman, J.J. (Netherlands Energy Research Foundation, Petten). May 1987. 40p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750036/JAW.

This investigation is initiated to investigate the technical and economic feasibility of the application of wind turbines for waste water purification plants. These plants use energy for pumping, aeration, grinding and heating. Description and specifications of the plant and the turbine (3-blade Bouma wind turbine with a rotor diameter of 16 m) are given. Energy consumption and -production, and wind regime are presented in tables. Investment- and maintenance costs, other expenses and energy prices justify the expectation that the use of wind turbines in these plants is profitable, even without subsidization. 13 figs., 6 refs., 7 tabs., 2 app.

597 **(SERI/STR—217-3219) Study of the potential for wind turbines in developing countries: Phase 1 report: A subcontract report.** (Strategies Unlimited, Mountain View, CA (USA); Solar Energy Research Inst., Golden, CO (USA)). Sep 1987. Contract AC02-83CH10093. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87012280/JAW.

The objective of this report is to identify a set of "candidate" developing countries for which further exploration of the potential of wind energy as a cost-effective alternative to conventional sources of electric power is warranted. The resulting ranked list of countries indicates where the potential for wind power seems more promising than it does elsewhere in the developing world. The study's timing and resources necessitated using currently available information on wind resources, grid power costs, load characteristics and other data for developing countries. Accordingly, the study should not be construed as providing definitive conclusions on the economic merits of wind relative to conventional sources of power in any one country or, in particular, in any one selected

region of a country. Such conclusions can only be reached as the result of intensive country and site specific investigations, for which this study suitably sets the stage. 8 refs., 24 figs., 15 tabs.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 547, 596

598 **(DOE/R4/10569—T2) Handbook on wind system deployment in Puerto Rico.** (Meridian Corp., Falls Church, VA (USA)). Jul 1985. Contract FG44-82R410569. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000889/JAW.

The purpose of this handbook is twofold: (1) to provide the Puerto Rico Office of Energy (PROE) with a concise overview of the steps involved in deploying wind energy conversion systems (WECS) on the Island; and (2) to provide recommendations to PROE for developing a one-stop-shop for streamlining WECS development in Puerto Rico. Information presented in this study is based on the findings of an institutional analysis conducted in July, 1983. 4 figs.

599 **(ECN-PB—87-2) Energy production of the BOHES experimental wind turbine, equipped with a hydraulic transmission system, at Moordrecht.** van der Borg, N.J.C.M.; Stam, W.J. (Netherlands Energy Research Foundation, Petten). Mar 1987. 49p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750035/JAW.

Bohemen Energy Systems (BOHES) has installed an experimental wind turbine with a hydraulic transmission at Moordrecht, Netherlands. The aim of this experimental facility for BOHES is to obtain information about the application of a hydraulic transmission in a wind turbine for the production of electrical and thermal power. Especially the behavior of the applied standard hydraulic components and the turbine control system was investigated. The Netherlands Energy Research Foundation (ECN) has performed measurements to characterize the energetic efficiency and the control behavior of the facility. These measurements have been carried out in the period between December 1984 and January 1986. The instrumentation for the measurement of the various quantities was partly provided by ECN and partly by BOHES. One of the transportable measurement sets of ECN was used for data acquisition. From the measurement results information was obtained concerning: the electrical power curve, the turbine efficiency and the annual energy production; the rotational speed as a function of the wind speed; some hydraulic quantities. No measurements have been done to quantify the thermal power of the facility. The most important conclusion is the fact that the electric power production of the tested facility is relatively low. This is due mainly to the relatively low rotational speed and the corresponding low rotor efficiency. Therefore the annual energy production can be improved by increasing the rotational speed and thus utilizing the optimal rotor efficiency. Furthermore, the annual energy production might be improved by: increasing the installed electrical power; optimizing the turbine control, including the prevention of motor operation; omission of redundant hydraulic components and a better dimensioning of the remaining components. 13 figs., 3 refs., 1 app.

600 **(PNL—6283) Using a new characterization of turbulent wind for accurate correlation of wind turbine response with wind speed.** Connell, J.R.; George, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001453/JAW.

The turbulence encountered by a point on a rotating wind turbine blade has characteristics that in some important respects are different from those measured by a stationary anemometer. The conventional one-peaked continuous spectrum becomes, broadly, a two-peaked spectrum that in addition contains a set of narrow-band spikes of turbulence energy, one centered on the frequency of rotor rotation and the others centered on multiples of that frequency. The rotational sampling effect on wind spectra is quantified using measurements of wind velocity by anemometers on stationary crosswind circular arrays. Characteristics of fluctuating wind are compared to measured fluctuations of bending moments of the rotor blades and power output fluctuations of a horizontal-axis wind turbine at the same site. The wind characteristics and the correlations between wind fluctuations and wind turbine fluctuations provide a basis for improving turbine design, siting, and control. 6 refs., 11 figs., 1 tab.

601 **(SAND—86-2164) Measurements and calculations of aerodynamic torques for a vertical-axis wind turbine.** Akins, R.E.; Berg, D.E.; Cyrus, W.T. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001783/JAW.

This report describes measurements of aerodynamic torque on a vertical-axis wind turbine. Accelerometers mounted at the equator of the rotor and a torque meter mounted at the base of the rotor were used to compute the net aerodynamic torque acting on the rotor. Assumptions concerning blade-response symmetry were required to achieve blade torque as a function of rotor position on each half of a revolution for a two-bladed rotor. Results are presented for tip-speed ratios from 2.5 to 8.0 for two turbine rotational speeds. Evidence of dynamic stall is observed at low tip-speed ratios. 13 refs., 31 figs., 15 tabs.

602 **(SAND—87-2079C) Design and control of a variable-speed generator system for a WECS [wind energy conversion system].** Ralph, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871062—4). NTIS, PC A02. Order Number DE88000740/JAW.

From Windpower '87; San Francisco, CA, USA (5 Oct 1987).

Sandia National Laboratories has been funded by the Wind/Ocean Technologies Division of the DOE to design and build a 34-meter diameter VAWT research Test Bed incorporating a constant frequency, variable speed generator system (VSGS). The turbine will be utilized to evaluate aerodynamic and structural dynamic technological advances and to develop and test variable speed control algorithms. These algorithms are intended to control the power output and increase the turbine fatigue life. The paper will discuss the design of the power system, VSGS and the control system hardware. The variable speed control algorithm development to date is also discussed. 6 refs., 5 figs.

603 **(SAND—87-2080C) The Sandia 34-meter VAWT [Vertical Axis Wind Turbine] test bed.** Ashwill, T.D.; Berg, D.E.; Gallo, L.R.; Grover, R.D.; Klimas, P.C.; Ralph, M.E.; Rumsey, M.A.; Stephenson, W.A.; Sutherland, H.J. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 11p. (CONF-871062—3). NTIS, PC A02. Order Number DE88000743/JAW.

From Windpower '87; San Francisco, CA, USA (5 Oct 1987).

The Wind Energy Research Division of Sandia National Laboratories has been funded by the Wind/Ocean Technology Division of the Department of Energy (DOE) to design and build a 34-meter diameter Vertical Axis Wind Turbine (VAWT) incorporating the results of recent research in VAWT aerodynamics and structural dynamics. The design and fabrication of all turbine parts has been completed, and construction of the turbine is now nearing completion, with preliminary testing underway. Turbine design and construction are reviewed and the major components of the system are summarized in this paper. 12 refs., 7 figs.

604 **(THE-TN-R—813-A) Pump rod forces due to hydrodynamic effects in piston pumps.** Verheij, F. (Technische Hogeschool Eindhoven (Netherlands). Afdeling Technische Natuurkunde). Oct 1986. 119p. Technische Hogeschool Eindhoven, Afdeling der Technische Natuurkunde, P.O. Box 513, 5600 MB Eindhoven, Netherlands.

A mathematical model has been set up to describe flow and pressure fluctuations in a pump system of a wind pump for single acting piston pumps. With this, hydrodynamic forces acting on the pump rod can be calculated. Hydrodynamic forces make an important contribution to the total pump rod force. Experiments have

been performed on a laboratory version of the so-called Tanzania pump. Different air volumes of the delivery airchamber, different delivery heads and different rotational speeds were chosen to obtain enough information to check the validity of the model. For the measuring and the elaboration of the measurements, computer programs were developed using a new data acquisition system. This new system operates very satisfactorily. A new magneto-inductive flow meter has been installed. However there are still incertainties as to the reliability of this sensor. Simple analytical expressions using Fourier transform analysis methods were obtained for the pressure and flow fluctuations in the pump system, from which the forces acting on the pump rod can be calculated. Comparison between theoretical and experimental results suggest that the pressure fluctuations are predicted correctly by theory. This is yet not the case in comparing theory and experiment with regards to the flow fluctuations. Apart from the irreliability of the flow meter, this could also be due to the complex flow in and out of the airchamber that is not correctly modelled in theory. There is certainly need for further analysis of the measurements possibly supplemented by a new set of measurements. However, design rules already can be derived from the results obtained so far. A good sizing of the airchamber in relation to the stroke volume of the pump keeps the pressure fluctuations, and so the fluctuating hydrodynamic forces acting on the pump rod, within bounds. 13 refs.

605 (TUD-IW—86006R) **Charts for the first two modes of bending eigenvibrations of rotating beams, which are made up of two different parts.** Joosse, P.A. (Technische Hogeschool Delft (Netherlands). Inst. voor Windenergie). Jun 1987. 33p. (In Dutch). Instituut voor Windenergie TUD, Kluyverweg 1, 2629 HS Delft, Netherlands.

Charts for eigenvibrations of a rotating beam are given. For one of the two beam parts, the 'blade part', two different mass- and stiffness distributions are described. With the help of these charts not-rotating eigenfrequencies are calculated. The calculated frequencies have errors up to a maximum of 5% and can be used in designing rotor blades of wind turbines. 22 figs., 3 tabs, 4 refs.

606 (TUD-IW—R518) **Performance measurements of the Kolibrie and FACT rotor blades without tipvanes on the full-scale experimental wind turbine.** Bruining, A. (Technische Hogeschool Delft (Netherlands). Inst. voor Windenergie). Apr 1987. 49p. Delft Univ. of Technology, Institute for Wind Energy, Kluyverweg 1, 2629 HS Delft, Netherlands.

This report contains the results of the drag measurements of the rotor hub sections alone without blades, the measurements of the blade drag, and the performance measurements on the Kolibrie- and FACT rotor. There were no tipvanes mounted. The measurements were carried out on the experimental full-scale wind turbine test facility in Hoek van Holland of the Delft University of Technology. The drag of the hub section of the Kolibrie rotor and the drag of both rotor systems were measured by turning the rotor plane parallel to the wind direction at a blade pitch adjusted to an average zero-lift coefficient. The drag of the hub section of the FACT rotor was measured perpendicular to the wind. The hub section of the Kolibrie rotor gives a rather high drag. The drag level of the hub section of the FACT rotor is roughly half of the drag level of the hub section of the Kolibrie rotor. The blade drag measurements are presented in plots which give the average blade drag coefficient as a function of the tip speed ratio lambda. The blade drag coefficient of the FACT rotor is also roughly the half compared with the blade drag coefficient of the Kolibrie rotor. The results of the performance measurements for blade tip pitch angles between -1.5 deg and +3 deg are given in C/sub P/-lambda plots. The covered tip speed ratios are between lambda = 5 and lambda = 15. The measured C/sub P/ of the FACT rotor was a little lower than expected. 10 figs., 5 tabs., 6 refs.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 5, 6, 9, 16, 26, 58, 75, 83, 142, 150, 152, 152, 157, 158, 163, 185, 187, 187, 196, 662, 673, 1106, 1526

607 (DOE/METC—87/6077, pp 19-30) **Advanced coal-fueled gas turbine systems: GM gas turbine overview.** Wilkes, C.; Ali, S.A.; Wenglarz, R.A.; Vaught, J.M.; Vogel, R.E. (General Motors Corp., Indianapolis, IN). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23165.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The advanced Coal-Fueled Gas Turbine Systems program is aimed at practical demonstration of the technology that will be required in order to proceed with commercialization of gas turbine power plants operating with direct coal firing. Allison Gas Turbine is conducting a program to develop components for such a coal-fueled gas turbine and to demonstrate operating feasibility of the overall system in a proof-of-concept engine test. Potential commercial applications are also being reviewed and subjected to economic analyses to ensure that the program is directed toward development of worthwhile end products for the commercial marketplace. The program includes a 24-month period of bench scale component development tests, followed by a further 24-month period of full scale component testing which culminates in engine system integration and testing of the complete proof-of-concept system. The major elements of this program are: reference system definition and economic analysis; fuel specification and procurement; combustion system design and development; particulate separator development; deposition, erosion and corrosion (DEC) studies; recuperator development; engine control system development; and engine system integration and test. Each of these are described and results to date on the first four elements as listed are discussed. 5 references, 6 figures.

608 (DOE/METC—87/6077, pp 44-53) **Westinghouse gas turbine overview: advanced coal-fueled gas turbine systems.** Hals, F.A.; Anast, K.R.; Koch, W.G.; Chamberlin, R.M. Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23167.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of this contract is to establish the technology base for coal-fired gas turbines targeted for the electric utility application. This effort divides into three major experimental elements. A subscale slagging combustor is first developed. After its development, the subscale combustor will be operated with a 500-kW gas turbine for coal-fired testing of the integrated system. Finally, a utility-sized combustor based on the subscale design will be tested. Each of these phases is described. The reference system definition and test fuel specifications are completed and are described. The design of the subscale combustion system is described. Testing of the system has not yet begun. 6 figures.

609 (DOE/METC—87/6077, pp 54-66) **Overview of A. D. Little - Cooper Bessemer program: coal fueled diesel engines for stationary power.** Balles, E.; Benedek, K.; Rao, K.; Cheng, W.; Kimberley, J. (Arthur D. Little, Inc., Cambridge, MA). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-85MC22182.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The goal of this program is to establish a foundation of knowledge which can serve as the basis for the development of a coal-fueled diesel engine for stationary power application. Cooper Bessemer, a leading manufacturer of large stationary engines, is approaching the coal engine development with a number of advantageous technical features and also a number of critical unresolved design issues. The advantages include low engine speed (300-450 rpm), unique jet-cell ignition technology, and common-rail fuel me-

tering and injection system which is relatively tolerant of particulate matter. Before the design and development of a prototype coal-fueled reciprocating engine can begin, basic questions about specific coal engine phenomena must be answered. Nine critical phenomena from the chronological perspective of an element of coal-fuel as it passes through the system are summarized: fuel cleaning at acceptable cost; injection and mixture preparation; nozzle erosion; ignition; combustion (timely); deposition; ash removal; ring and valve wear; emissions control at acceptable cost; and turbine wear. The objective of this project is to conduct highly focused exploratory studies in these areas, with particular emphasis on the injection and wear questions. Results to date are discussed. 5 references, 5 figures, 5 tables.

610 (DOE/METC—87/6077, pp 109-113) **Extending and enhancing the scientific base for advanced coal-fueled power systems utilizing heat engines.** Kamo, R.; Kakwani, R. (Argonne National Lab., IL). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23258.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objectives of this program are to improve the combustion efficiency of coal fuel in a diesel engine, thereby increasing the coal fueled engine's thermal efficiency. Improvements in the combustion efficiency of coal fuel is expected to result in lower contaminants in the combustion gases. The thermal ignition combustion system (TICS) concept for the micronized coal combustion, discovered in an earlier contract with METC, will be further studied to enhance the combustion of coal powder fuel, fumigated with the intake air, in an adiabatic diesel engine. 3 references.

611 **(EPRI-CS—5378) Continuous vibration signature analysis: Rotating equipment monitoring: Final report.** Reeves, C.R.; Conover, M.F.; Vinson, J.W. (Radian Corp., Austin, TX (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 210p. Research Reports Center, Box 50490, Palo Alto, CA, 94303. Order Number TI88920019/JAW.

This report discusses automated vibration signature analysis techniques for predictive maintenance of the critical rotating machinery in utility power plants. Machinery maintenance is currently a significant problem for the utility industry, with as much as half of fossil fueled plant down time caused by mechanical failures and maintenance activities. This project has developed and demonstrated predictive maintenance techniques for reducing down time and improving plant availability through early detection of incipient failures, thereby permitting the planning, scheduling and timely performance of maintenance before more serious conditions develop or catastrophic failure occurs. This report focuses on the development and demonstration of the Rotating Equipment Monitoring System (REMS) at United Illuminating Company's New Haven Harbor Station. REMS is an on-line, computerized vibration signature analysis system designed to monitor critical rotating equipment such as turbine-generators, large pumps and fans in utility power plants. The design, installation and features of the system at New Haven Harbor Station are described in detail. A predictive maintenance program based on REMS has been developed and used for more than three years. This program is described. Several maintenance case histories are presented which have demonstrated cost savings of $1,000,000 or more through the use of REMS. A cost/benefit analysis is presented that shows the program to be highly cost effective. The report includes a system specification which may be used by utilities as a guideline for the acquisition of an automated vibration monitoring system. 17 refs., 32 figs., 5 tabs.

612 **(PB—87-214086/XAB) Preliminary site evaluation report on Potomac Electric Power Company's proposed station H. Final report.** (Maryland Power Plant Research Program, Annapolis (USA)). Jun 1987. 288p. (PPRP/PPSE/SH—1). NTIS, PC A13/MF A01.

This report provides a preliminary environmental assessment of two 375-MW Coal Gasification-Combined Cycle (GCC) units which the Potomac Electric Power Company proposes to construct on their existing Dickerson Generating Station site in western Montgomery County, Maryland. A mass-burn municipal solid-waste incinerator is also proposed at the site by Montgomery County. Research on the GCC technology and data for the air, land, and water environs in and around the site indicates that the proposed GCC technology offers substantial engineering, environmental, and economic benefits. Overall environmental impacts should be less than those anticipated for a comparably sized pulverized-coal power plant. Projected air, land, and water impacts appear to be within any applicable regulatory standards or limitations. However, four areas of concern were identified which could be of significant consequence to the suitability of the site. Recommendations are provided for detailed site evaluations including monitoring recommendations to fill data or information gaps.

613 **(PB—87-219473/XAB) Fuji electric journal, Vol. 60, No. 5, 1987.** (Fuji Electric Co. Ltd., Tokyo (Japan)). 1987. 94p. (In Japanese). NTIS, PC E04/MF E01.

Text in Japanese with English abstracts. See also PB—87-194908.

Contents include: Advanced Technology of Steam Turbines; Fuji Electrics Present Conditions of Power Generation Engineering; Recent Topics of Geothermal Power Plants; Advanced Technology of Turbogenerators; Diagnostic Technology of Remaining Life for Fossil Fuel Power Plants; Recent Control Systems for Thermal Power Plants; Recent Techniques of Water Turbines; Recent Technology of Industrial Thermal Power Plants; Latest Control and Protection Techniques for Hydraulic Power Plants; Progress of Hydraulic Power Rural Large Bulb Turbines and Generator for New Martinsville Power Station, U. S. A.; Large Capacity Generator-Motor and Static Converter Starting System for Palmiet Pumped-Storaged Scheme; Total Adaptive Generation Controller Using Multi-Variables; Hydraulic Power Plant Operation Training Simulator; and Monitoring System for Transformers.

614 **(PB—87-220372/XAB) Can a heat-transfer analysis predict multiple steady states in a sodium-heated steam generator.** Atthey, D.R. (Central Electricity Generating Board, Southampton (UK). Technology Planning and Research Div.). 1987. 42p. (TPRD/M—1582/R86). NTIS, PC E05/MF E05.

This report presents an analysis of a simplified model of a sodium-heated steam generator applying the concept of boiling curves. The method follows a previously published study by Llory et al. (1984), which predicted multiple steady-state solutions under certain operating conditions, each steady state corresponding to a different position of the dryout front. The form of results obtained by Llory et al. is reproduced in this report. It is shown that the method used in that study was based on an incomplete interpretation of the dryout phenomenon. In this analysis it was possible to show that, for any given sodium inlet temperature, all but one of the steady states can be rejected on physical grounds. The analysis was also extended to examine the effect of the application of the boiling-curve method to local conditions of temperature and heat flux around the dryout front.

615 **Power generating system and method utilizing hydropyrolysis.** Tolman, R. (to Dept. of Energy). US Patent Application 6-947,936. 30 Dec 1986. 36p. Contract W-7405-ENG-36. DE88000856 NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000856/JAW.

A vapor transmission cycle is described which burns a slurry of coal and water with some of the air from the gas turbine compressor, cools and cleans the resulting low-Btu fuel gas, burns the clean fuel gas with the remaining air from the compressor, and extracts the available energy in the gas turbine. The cycle lends itself to combined-cycle cogeneration for the production of steam, absorption cooling, and electric power.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 47, 73, 75, 82, 83, 85, 86, 87, 89, 90, 91, 92, 93, 98, 99, 152, 187, 436, 1735

616 (EPRI-CS—5361-Vol.1, pp 1.1-1.5) **New environmental agenda and the coming commitment to NO/sub x/ control.** Ayres, R.E. (Natural Resources Defense Council, Washington, DC). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

As the recent ideological approach to environmental problems wanes, a new environmental agenda for the remainder of this century is emerging. Controlling nitrogen oxides emissions from stationary sources - a pollutant with serious effects on public health, environmental integrity, and esthetic experience - is part of this agenda. Development of new technology is welcome. But political leaders must not be permitted to use technological change as an excuse for avoiding the use of existing NO/sub x/ control technologies now.

617 (EPRI-CS—5361-Vol.1, pp 2.1-2.29) **Decline of boreal montane forest ecosystems in Central Europe and the Eastern North America; links to air pollution and the deposition of nitrogen compounds.** Bruck, R.I. (North Carolina State Univ., Raleigh). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Recently presented evidence of anamolous growth declines and dieback of eastern forests has captured public concern and strengthened the call to resolve the longstanding question of the role of atmospheric deposition in the decline of forest trees. Recent evidence relevant to determining if there are effects of atmospheric deposition on forests of the eastern US is presented. A scenario might involve various forms of concentrated pollution being deposited via cloud deposition, causing above and below ground nutrient and microbial imbalances or direct physiological aberrations to spruce and fir trees. These chronic perturbations could lead to a predisposition of the ecosystem, to the effects of many indigenous pathogens and insects, and/or weaken the trees resistance to the effects of severe climate. Continued research to integrate the findings of long term studies with relevant atmospheric monitoring data will create a clearer picture of the potential of atmospheric pollution to affect American forest resources.

618 (EPRI-CS—5361-Vol.1, pp 3.1-3.6) **Overview of environmental issues related to nitrogen oxides in the atmosphere.** Hakkarinen, C. Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Atmospheric nitrogen oxide compounds, including N_2O, NO and NO_2, have been implicated in a variety of environmental effects, both from their direct emission to the atmosphere and their role in the formation of secondary compounds, such as ozone and nitric acid. High temperature fossil fuel combustion is a principal source of atmospheric NO/sub x/ emissions, hence the electric utility industry has a strong interest in understanding their environmental fate. An overview of the current state of scientific knowledge on the transport, conversion and fate of NO/sub x/ compounds in the atmosphere is presented. Emphasis is given to: the relationship between NO_2/ozone and effects on human health; the role of nitrogen compounds/ozone in the perceived decline of some North American forests; the contribution of nitrogen compounds to the formation of acidic precipitation; and the role of nitrogen oxides (principally, N_2O) in regulating global climate (the greenhouse effect) and influencing the stratospheric ozone layer (the polar ozone hole). A brief summary of major research underway at EPRI and elsewhere that addresses environmental issues related to nitrogen oxides is presented.

619 (EPRI-CS—5361-Vol.1, pp 4.1-4.25) **Role of nitrous oxide (N_2O) in global climate change and stratospheric ozone depletion.** Tirpak, D.A. (Environmental Protection Agency, Washington, DC). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Several recently completed scientific assessments have concluded that there is a significant potential for global atmospheric change - climate change and stratospheric ozone depletion - to occur in the next few decades. Nitrous oxide (N_2O) is a critical element in both issues. Although the problem of global climate change was once synonomous with carbon dioxide, there is growing recognition of the role of other trace gases. Chlorofluorocarbons, N_2O, methane, and other trace gases now account for roughly half of the warming from greenhouse gases in the atmosphere, and by the year 2030 may lead to twice as much warming as from carbon dioxide alone. The US Congress has asked the US Environmental Protection Agency to prepare a report on policy options to stabilize these trace gas concentrations. The role of N_2O in global climate change and stratospheric ozone depletion is evaluated. Trends in N_2O concentrations are summarized. The understanding of current and projected emission sources and emission factors is reviewed. The twin issues of climate change and ozone depletion are discussed. Topics for further study are recommended.

620 (EPRI-CS—5361-Vol.1, pp 5.1-5.27) **Overview of recent developments in NO/sub x/ control in Europe.** Rentz, O. (Univ. of Karlsruhe, West Germany). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Based on the emission control legislation in some European countries recent developments are presented leading to the current status of NO/sub x/ abatement technologies and their application to stationary sources (power plants and industrial processes). The state of DeNO/sub x/ implementation in Europe in the field of primary and secondary NO/sub x/ emission control is outlined. This including information on initial status at both full-scale and pilot plants, available and applied control technologies, transfer problems with regard to site specific conditions, advanced problem solutions and state of commissioning. The future application of DeNO/sub x/ technologies at industrial processes is briefly outlined. Investment and cost figures are discussed.

621 (EPRI-CS—5361-Vol.1, pp 6.1-6.15) **Large scale testing and development of the B & W low NOx cell burner.** Clark, M.J.; LaRue, A.D.; Liang, A.D.; Eskinazi, D. (Babcock & Wilcox, Barberton, OH). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Due to environmental concerns, fossil fuel power plants built prior to New Source Performance Standards (NSPS) may be required to reduce nitrogen oxide (NOx) emissions. A large segment of these units are equipped with cell burners which are producing relatively high NOx emissions, in the 1.0 to 1.8 lb/million Btu range. Babcock & Wilcox and EPRI have developed a low NOx burner that is directly retrofittable to cell burner units. The continued development of this new burner is described. Results of recent pilot combustion tests (100 MBtu/hr) conducted at EPA's Large Watertube Simulator (LWS) agree well with prior smaller-scale pilot performance. NOx reductions were typically 55 to 75% while achieving combustion efficiency of 99.5% in the test furnace. A full scale Low NOx Cell was installed at Dayton Power and Light's Stuart Station and has been in operation since March, 1985. The Low NOx Cell retrofit involves near-burner coal piping alteration but no pressure part modifications. At Stuart Station, the burner's operation and mechanical reliability has been demonstrated over a two-year period. A full scale retrofit demonstration is planned to confirm the commercial viability of this burner in a full scale retrofit.

622 (EPRI-CS—5361-Vol.1, pp 7.1-7.29) **Low NOx developments on an integrated combustion and environmental test facility.** Vatsky, J.; McMillan, R. (Foster Wheeler Energy Corp., Livingston, NJ). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

A test facility, equipped for a wide range of combustion and emission-control related testing, has been in operation for approximately eighteen months, firing a wide variety of pulverized fuels, from sub-bituminous coals to very low volatile fuels such as petroleum coke. Initially, an extensive test program was performed with both petroleum coke and bituminous coal with an arch-fired furnace configuration. More recently, testing has begun with a two-burner high horizontally-fired configuration. Although these programs were designed to evaluate NOx emissions, and levels of about 0.15 lb/million Btu have been obtained, the Combustion and Environmental Test Facility is also designed to facilitate testing of SO_2 control systems. The CETF is described and initial results obtained from both the arch-and horizontally-fired modes are summarized.

623 (EPRI-CS—5361-Vol.1, pp 8.1-8.23) **Development of overfire air design guidelines for front-fired boilers.** Lisauskas, R.A.; McHale, C.E.; Afonso, R.; Eskinazi, D. (Riley Stoker Corp., Worcester, MA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Experimental flow model data and technical and economic studies have been used to develop design guidelines for overfire air (OFA) NO/sub x/ control systems. Conventional and novel OFA configurations were investigated in a one-twelth scale furnace model using detailed temperature and velocity maps to quantify overfire air injection and mixing. Data analyses focused on translating the flow model test results into practical designs for front-fired utility boilers. Based on the experimental results, the feasibility of retrofitting new OFA configurations on a specific utility boiler was examined. The results for several test configurations are used to develop preliminary overfire air design guidelines for front-fired boilers. For tradiational design configurations with one overfire air port located over each burner column, the best mixing occurs at an injection to furnace velocity ratio of 4 to 6. A significant improvement in upper furnace mixing can be achieved by adding wing overfire air ports and biasing the air flow and velocity from the center to the wing ports.

624 (EPRI-CS—5361-Vol.1, pp 9.1-9.16) **Furnace design and application on low NOx pulverized coal combustion.** Kiga, T.; Miyamae, S.; Makino, K.; Ikebe, H. (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Coal properties such as fuel ratio and fuel nitrogen are generally well-known to give an effect on NOx emission. The authors have already developed low NOx pulverized coal burner which gives 150 ppm of NOx or less for Japanese domestic coal with conventional staged firing, however, most of various kinds of imported coals ensured significant higher NOx emission with conventional type furnace. Therefore, the authors attempted to develop low NOx type furnace applied the method named INPACT, according to the results of the fundamental researches. With application of this method to a 600 MW utility boiler, in conclusion, the authors obtained low NOx emission of less than 150 ppm of the guarantee value for coals ranked from 1.5 to 2.2 as fuel ratio and remarkable NOx reduction of less than 100 ppm was also obtained. The fundamental furnace design concept and its application results are discussed.

625 (EPRI-CS—5361-Vol.1, pp 10.1-10.14) **Gas reburning-sorbent injection: a combined No/sub x//SO/sub x/ control technology.** Bartok, W.; Folsom, B.A.; Kurzynske, F.R. (Energy and Environmental Research Corp., Irvine, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Gas Reburning-Sorbent Injection (GR-SI) involves co-firing pulverized coal with natural gas in combination with sorbent injection and/or coal cleaning to allow for cost effective reduction of acid raid precursor emissions (NO/sub x/ and SO/sub x/) from pre-NSPS coal fired utility boilers. This would provide the utility industry with flexibility in fuel selection to satisfy potential acid rain control legislation. A demonstration project is described which will be cooperatively funded by the Department of Energy, the Gas Research Institute and the State of Illinois Department of Energy and Natural Resources, to demonstrate GR-SI on three coal fired utility boilers located in the State of Illinois. Gas Reburning-Sorbent Injection will be applied to one each of wall, corner and cyclone fired boiler types with overall reduction targets of 60% in NO/sub x/ and 20% in SO/sub x/ emissions. The overview of the planned demonstration project is discussed, including design consideration and economic projections for GR-SI applications.

626 (EPRI-CS—5361-Vol.1, pp 11.1-11.17) **Pilot scale studies on the application of reburning for NO/sub x/ control.** McCarthy, J.M.; Chen, S.L.; Seeker, W.R.; Pershing, D.W. (Energy and Environmental Research Corp., Irvine, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

A pilot scale experimental study is described which addressed parametric and mixing effects of the reburning process, an in-furnace NO/sub x/ reduction technology, and scaling information and design and operation guidelines for application of reburning under a wide variety of conditions for coal- and oil-fired boilers are also presented. The results demonstrate the potential of reburning for NO/sub x/ reduction, and indicate that important parameters include primary zone burnout, reburning zone time, temperature, and stoichiometry, and reburning coal transport medium. Rapid dispersion of the reburning fuel is desirable for primary NO/sub x/ incineration but can lead to an overall decrease in efficiency if the reburning fuel contains fuel nitrogen and is carried by an oxygen-rich medium. Recirculated flue gas is the optimal reburning coal transport medium, but efficient NO/sub x/ reduction with air transport can be achieved if higher reburning fuel ratios and optimal reburning mixing rates are employed. Natural gas is more effective than either coal or heavy fuel oil for reburning, especially at low primary NO/sub x/ concentrations. Reburning with coal or natural gas has little adverse effect on burnout performance. Comparison of pilot scale results and bench scale data shows that parametric effects are independent of scale and that a 50% reduction in emissions is achieved with 20% coal reburning at normal primary NO/sub x/ levels.

627 (EPRI-CS—5361-Vol.1, pp 12.1-12.18) **Reburning with low and medium Btu gases.** Bortz, S.J.; Offen, G.R. (KVB, Inc., Irvine, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Experiments have been conducted in a 0.5 x 10^6 Btu/hr test furnace to assess the effectiveness of low and medium Btu gases as reburning fuels. These fuels, produced by coal gasification, have only trace amounts of hydrocarbons, with the combustible fraction being mainly H_2 and CO. Situations where gasification fuels may be of interest for reburning would be cyclone combustors which used crushed coal as a fuel, or boilers where there is insufficient residence time for reburning with coal. The experimental results show that the gasification fuels can reduce NO/sub x/ created in the primary flame although not as effectively as hydrocarbon fuels. Typically, the gasification fuels gave 20-30% reduction of primary zone NO/sub x/ compared to 60-70% for natural gas. If the primary

zone NO/sub x/ emissions are controlled by reducing the primary zone stoichiometry to between 1.0 and 1.05, 60% overall NO/sub x/ reduction (compared to an uncontrolled flame) can be achieved with 15-20% use of simulated Lurgi reburning fuel. Under the same conditions, nearly 80% overall NO/sub x/ reduction was achieved with natural gas reburning.

628 (EPRI-CS—5361-Vol.1, pp 13.1-13.21) **1987 update on NOx emissions control technologies at Combustion Engineering.** McCartney, M.S.; Kokkinos, A.; Lewis, R.D.; Hellewell, T.D.; Cohen, M.B. (Combustion Engineering, Inc., Windsor, CT). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

As the owners and operators of fossil fuel fired steam generators plan for the 1990's, new emphasis is being placed on the control of NOx emissions. This emphasis is the result of a resurgence in the concern, both domestically and internationally, regarding the effects that NOx emissions may have on the environment. At Combustion Engineering, work is continuously underway to support these owners and operators. As shown in previous Joint NOx Control Symposia, Combustion Engineering has a diverse array of NOx Reduction Technologies available to address a range of possible reductions dictated by future regulations. These technologies have been developed by Combustion Engineering and Mitsubishi Heavy Industries (MHI); MHI developed technologies have been licensed to Combustion Engineering. A synopsis of each of these technologies and the applications and operating experience related to them is presented.

629 (EPRI-CS—5361-Vol.1, pp 14.1-14.20) **Update of NO/sub x/ control technologies at Riley Stoker.** McHale, C.E.; Lisauskas, R.A. (Riley Stoker Corp., Worcester, MA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Recent design and operating experience with Riley Stoker low-NO/sub x/ combustion systems in pilot scale and commercial furnaces is reviewed. The performance of several commercial low-NO/sub x/ burner installations in wall- and Turbo-fired furnaces is described. Both emissions reductions from uncontrolled levels and the impact of the combustion process modifications on furnace temperatures are discussed. Pilot scale results focus on in-furnace NO/sub x/ and SO_2 control processes such as reburning and sorbent injection. Recent activities include CCV burner design refinements, and developing staged combustion systems for utility boilers, industrial stoker-fired boilers and circulating fluidized bed combustors. Since jet aerodynamics influence combustion and NO/sub x/ reduction efficiencies, two-phase jets in furnace enclosures are discussed.

630 (EPRI-CS—5361-Vol.1, pp 15.1-15.29) **Industrial and utility boiler low NO/sub x/ control update.** Vatsky, J.; Schindler, E.S. (Foster Wheeler Energy Corp., Livingston, NJ). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

NO/sub x/ control has been passing through various phases as the regulatory and commercial climate have changed since the early 1970's. During the decade of the '70's emphasis by boiler manufacturers was on developing and field demonstrating NO/sub x/ controls to meet the New Source Performance Standards of 1971 and 1979. More recently, with the reduced need for new utility generating capacity, emphasis has shifted to retrofittable technologies to meet pending acid rain control legislation. Field experience with Foster Wheeler's low NO/sub c/ coal burner which is an inherently retrofittable design, on industrial and utility boilers is discussed. New concepts and their potential uses are also outlined.

631 (EPRI-CS—5361-Vol.1, pp 16.1-16.16) **NOx control update - 1987.** LaRue, A.D.; Cioffi, P.L. (Babcock & Wilcox, Barberton, OH). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Babcock & Wilcox is expanding its low NOx technology and product lines to include system directly suited for uncontrolled sources and for an increasing variety of new boiler applications. The low NOx cell burner has successfully completed two scales of combustion testing and initial field trials, and awaits a full boiler demonstration. The XCL burner was developed to reduce NOx below existing low NOx burner capabilities while providing individual burner air flow measurement and other features to improve performance. Reburning is being investigated as a NOx control measure for cyclone-fired boilers. NOx emissions are controlled with gas- and oil-fired units by use of PG-Dual Register Burners combined with NOx ports and gas recirculation. Further NOx reduction can be achieved by use of In-furnace NOx Reduction. Fluid beds provide NOx control by virtue of the combustion methodology, and lower NOx levels can be reached by staging. Refuse systems often face wide range of emission limitations and the Controlled Combustion Zone (CCZ) furnance offers potential for improved combustion and lower NOx when firing refuse-derived fuel. An update is provided on the technology and products used by B & W to control NOx emissions in these applications.

632 (EPRI-CS—5361-Vol.1, pp 17.1-17.20) **Federal Clean Coal Program.** Siegal, J. (Dept. of Energy, Germantown, MD). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

The Department of Energy's Clean Coal Technology Program is discussed. The program is broader in scope than just the control or prevention of pollutants from coal using machines. The energy needs of the US economy, i.e., coal technologies which can compete with oil and gas for markets which are now dominated by oil and gas; coal technologies which will allow utilities to cut the long lead times now necessary to design and construct conventional coal-fired boilers with scrubbers; and coal technologies which not only control SO_2 and NO/sub x/ to NSPS or better levels, but which also are more efficient and produce more easily disposable wastes that the conventional technologies are described. The objective is to examine the scope of this effort, present on overview of the R & D activity, including the recently initiated clean coal demonstration program, and discuss the attributes of the technologies which should ensure that once demonstrated, they will be used commercially.

633 (EPRI-CS—5361-Vol.1, pp 18.1-18.20) **Development status of B & W's second generation low NO/sub x/ burner - the XCL burner.** LaRue, A.D.; Acree, M.A.; Masser, C. (Babcock & Wilcox, Barberton, OH). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Due to the national concern with acid rain, the US NO/sub x/ emission standards may become more stringent for new sources, and uncontrolled sources may face NO/sub x/ emission limits. B & W has consequently proceeded to develop a second generation low NO/sub x/ pulverized coal (PC) burner suitable for new or retrofit applications. A primary objective is to minimize NO/sub x/ by burner design to avoid slagging and corrosion concerns associated with staged furnace operation. Development of the XCL burner stemmed from the technology of Babcock Hitachi's HT-NR burner design. The development program was cosponsored by the EPA, and consisted of full scale (80 million Btu/hr) tests of a standard Dual Register burner, an HT-NR burner, and XCL burner. Air flow tests were conducted to characterize flow patterns and improve swirl efficiency, and combustion tests were performed to evaluate and minimize emissions. The XCL burner proved capable of NO/sub x/ emissions (unstaged) of 0.3 to 0.5 lb/million Btu with high efficiency and adjustable flame shape. Consequently, a full complement of XCL burners was retrofitted to Ohio Edison's Edgewater Unit 4 for the EPA Limestone Injection Multistage Burner (LIMB) demonstration. The paper describes development and field results with the XCL burner.

634 (EPRI-CS—5361-Vol.1, pp 19.1-19.14) **Reductions in NO/sub x/ emissions from a 500MW corner fired boiler.** Allen, J.W.; Brooks, W.J.D.; Burdett, N.A.; Clarke, F.; Foley, G. (NEI International Combustion Ltd., Derby, England). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

The Central Electricity Generating Board is investigating methods for reducing the emissions of NO/sub x/ from fossil-fired power stations. Low-NO/sub x/ technologies usually involve radically different combustion regimes within the boiler compared to conventional units and, therefore, it is necessary to investigate their cost-effectiveness by undertaking large scale and long term trials. The results are presented of a program undertaken to investigate the characteristics of the rich-fireball technique installed in a 500MW(e) coal fired boiler at Fiddler's Ferry Power Station, England. Data are presented showing the impact of operational parameters on NO/sub x/ emissions. It is concluded that the introduction of this technique has resulted in a reduction of NO/sub x/ emissions of between 31 and 38%, depending on the mills in service.

635 (EPRI-CS—5361-Vol.1, pp 201-20.15) **Application of Mitsubishi Advanced MACT in-furnace NOx removal process at Taio Paper Co., Ltd. Mishima Mill No. 18 boiler.** Araoka, M.; Iwanaga, A.; Sakai, M. (Mitsubishi Heavy Industries, Ltd., Tokyom, Japan). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Mitsubishi Heavy Industries, Ltd. has been engaged in the research and development of new technology concerning the prevention of air pollution. In the field of low NOx combustion technology many counter-measures have been developed, for example, super low NOx PM burners and MACT system which have already been introduced at the former symposiums. The Advanced MACT system has been successfully developed and put into practical use. This Advanced MACT system and its application and operating experience at Taio Paper Co., Ltd., Mishima Mill No. 18 Boiler are described.

636 (EPRI-CS—5361-Vol.1, pp 21.1-21.20) **Operating experiences of coal fired utility boilers using Hitachi NOx reduction burners.** Narita, T.; Koda, F.; Masai, T.; Morita, S.; Azuhata, S. (Babcock-Hitachi K.K., Tokyo, Japan). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Babcock-Hitachi K.K. has replaced Dual Register Burners with Hitachi NOx Reduction burners (HT-NR) on two coal fired 200 MWe boilers. The HT-NR burner was developed, as previously reported, to apply the concept of In-Flame NOx Reduction. The two retrofitted boilers have achieved further NOx reduction, without increased unburned carbon contents or any other operating problems. Actual NOx emissions depend on the volatile matter content of the coal and, with highly volatile coal, emissions range from 70 to 75 ppm (6 % O_2). Five different coals are being fired in these units. Rapid ignition and flame stabilization are enhanced by use of a new type ceramic stabilizer. Even lower levels of NOx and unburned carbon can be achieved by increasing the coal fineness.

637 (EPRI-CS—5361-Vol.1, pp 22.1-22.19) **Long-term versus short-term data analysis methodologies: impact on the prediction of NO/sub x/ emission compliance.** Smith, L.L.; Rush, R.; Pitts, W.S. III; Flora, T. (Energy Technology Consultants, Irvine, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Over the last two decades, considerable NOx data from utility and industrial boilers has been accumulated. The data sources range from short-term test results to data obtained from continuous emission monitors from Subpart Da utility boilers. Depending upon the ultimate use of these two types of data, different interpretations of the emission results can be obtained. This can have far reaching impacts if the interpretation of the data is sued to establish the long-term effectiveness of NOx control technologies or to establish new or revised emission standards. A discussion of the potential ultimate uses of both short-term and long-term data is presented. The value of both is discussed in terms of their use for establishing emission control trends, operating and retrofit guidelines and emission standard setting. Statistical analysis methodologies are presented for interpreting long-term data and illustrations of Time Series Analysis are presented for interpretation of this data.

638 (EPRI-CS—5361-Vol.1, pp 23.1-23.18) **Engineering and economic analysis of retrofit low-NO/sub x/ combustion systems.** Lisauskas, R.A.; Snodgrass, R.J.; Johnson, S.A.; Eskinazi, D. (Riley Stoker Corp., Worcester, MA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

The feasibility of retrofitting low-NO/sub x/ combustion controls on four different utility wall-fired boiler designs has been evaluated. This evaluation included an engineering analysis of all equipment modifications, and a cost estimate for each retrofit option. Consideration was given to boiler physical limitations and operating constraints, as well as achieving NO/sub x/ reduction. NO/sub x/ emission predictions were based on correlations developed from both field installations and large pilot-scale combustion tests. The following low-NO/sub x/ combustion processes were evaluated: low-NO/sub x/ burners, conventional air staging (overfire air), advanced air staging (overfire air), and reburning. Costs are presented in terms of $/kW, mills/kWh, and $/ton of NO/sub x/ removed. The cost of retrofit NO/sub x/ controls were found to vary with unit size and retrofit complexity. Depending on the level of boiler modifications required, the capital cost of retrofit combustion controls can vary from less than $3/kW to more than $20/kW.

639 (EPRI-CS—5361-Vol.1, pp 24.1-24.28) **Influence of fuel properties and boiler design and operation on NOx emissions.** Pohl, J.H.; Dusatko, G.C.; Orban, P.C.; McGraw, R.W. (Energy Systems Associates, Tustin, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920561/JAW.

In 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.

Methods to predict the dependence of NOx emissions on coal properties, burner design and operation, and boiler design and operation are unreliable, complicated, or both. The functional dependence of NOx emissions on a number of these parameters was determined using data available in the literature. The functional dependences were then used to successfully explain the changes in NO emissions observed for: (1) a 660 MWe boiler firing two bituminous coals with volatile contents of 26.3% and 18% as received, and (2) two wall-fired 30 MWe units and a 137 MWe tangential unit firing a single coal with a volatile content of 24% as received. The change in the NOx with coal, primary air velocity, load, and excess oxygen content is discussed.

640 (EPRI-CS—5361-Vol.2, pp 25.1-25.29) **Current status of SCR in Japan.** Nakabayashi, Y.; Abe, R. (Electric Power Development Co., Ltd., Tokyo, Japan). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

Selective Catalytic Reduction of NOx is widely applied to utility and industrial boilers in Japan. Among utility boilers, 99 units of them (approx. 110 million Nm^3/h) have been equipped with SCR including 22 units of coal firing boilers (approx. 20 million Nm^3/h). Among industrial boilers, 31 units of them (approx. 3.3 million Nm^3/h) have also been applied with SCR (as of April 1986). SCR installation started in 1977 for oil and gas and in 1979 for coal firing boilers. These operating experiences suggested that the cost and performance of SCR should be discussed again, because the catalyst itself (life, volume requirement, etc.) has been improved remarkably. These facts are discussed from the utility standpoint.

641 (EPRI-CS—5361-Vol.2, pp 26.1-26.22) **Operating experience with the SCR DeNOx plant in unit 5 of Altbach/ Deizisau Power Station.** Necker, P. (Neckarwerke Elektrizitaetsversorgungs-AG, Esslingen, West Germany). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The SCR DeNOx plant in Unit 5 (420 MW) of the Altbach-Deizisau Power Station has been in operation since late 1985. The plant represents a retrofit to an existing plant and is designed as a partial flow plant (1.1 million/m^3h = 80% boiler load). The experience obtained after 6000 hours of operation (by the end of 1986) has shown that it is possible to observe the 200 mg NOx/m^3 limit value stipulated in Germany when consideration is given to the accompanying conditions illustrated with full flow plants. The demands placed on the partial flow plant of Unit 5 are particularly high. The reduction in activity of the catalytic converter is within the expected range after 6000 hours of operation. A partial air preheater wash carried out on a test basis produced air preheater water which had a high NH_3 content initially only. The waste water from the flue gas desulfurization plant contains only a small quantity of NH_3. The NH_3 values for the flue-dust must be monitored carefully, since they may result in special stipulations being made for operation of the DeNOx plant. The maintenance effort for the operational measuring equipment required for the DeNOx plant is relatively high.

642 (EPRI-CS—5361-Vol.2, pp 27.1-27.19) **VKR full-scale SCR experience on hardcoal fired boilers.** Goldschmidt, K. (VEBA Kraftwerke Ruhr AG, Gelsenkirchen, West Germany). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

VEBA Kraftwerke Ruhr (VKR) operates powerplants in Northrhine-Westfalia of the Federal Republic of Germany with a total capacity of 5500 MW gross. Most of the boilers are fired with high ballast hardcoal. Older boilers have a wet bottom furnace, newer one's are the dry furnace type. The great furnace ordinance of Germany calls for a NOx emission rate 200 mg/m3, i.e., 98 ppm, so all great boilers must be retrofitted by DENOX systems. Meanwhile VKR reduced NOx emission from their boilers by primary methods as far as possible. Since the end of 1984, VKR operated up to 8 pilot-plants to prove the SCR technology. Since end of 1985, 100% of fluegas from district heating boiler Buer (dry bottom, 150 MW) and since mid 1986, sponsored by UBA, 50% of fluegas from boiler Knepper C (molten ash, 370 MW) are treated by SCR high dust technology. Basing on pilotplant-tests, both DENOX demonstration units, their operation and the obtained finding are described.

643 (EPRI-CS—5361-Vol.2, pp 28.1-28.18) **Applicability of European SCR experience to US utility operation.** Cichanowicz, J.E.; Offen, G.R. Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

Approximately 2200 MW of selective catalytic reduction (SCR) capacity are operating or in start-up in Europe as of February 1987. Five full-scale systems are currently operational in the Federal Republic of Germany and two in Austria. Each unit has logged between 2000 and 6000 hours of operation. Experience from these SCR installations will assist defining the cost and technical feasibility of SCR for potential US application. The relevant experience anticipated from these and other European installations is discussed. Experience that will directly apply to US conditions is summarized, as are topics which are not relevant to US application due to plant design and fuel limitations. The European SCR installations are first briefly surveyed, and the significant design and operating features reviewed. Relevant experience is categorized into four topics: (1) SCR catalyst design, (2) catalyst lifetime, (3) process control and (4) plant integration. Finally issues critical to the analysis of SCR technical feasibility and cost for high sulfur coal-fired plants are summarized.

644 (EPRI-CS—5361-Vol.2, pp 29.1-29.11) **Comparison of four catalysts used in selective catalytic reduction of NO/sub x/.** Herrlander, B. (Flaekt Industri AB, Vaexjoe, Sweden). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The catalysts all showed a pseudo first order reaction. High activity and high specific surfaces are beneficial for the performance, even though high specific surfaces also means smaller pitch and higher pressure drop. The operating experiences were good, with no catalyst activity deterioration.

645 (EPRI-CS—5361-Vol.2, pp 30.1-30.15) **Improvement of NH_3 injection control system for a selective catalytic NOx removal system.** Suyama, K. (Mitsubishi Heavy Industries, America Inc., Windsor, CT). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

Mitsubishi Heavy Industries has supplied the Selective Catalytic NOx Removal system (SCR system) of more than 90 units both in Japan and abroad since it delivered the first SCR system for a boiler in 1976. The control system of a SCR system developed with a new concept to cope with the recent trend to operate a thermal power plant as a load swing operation unit and its service results in a 600 MW boiler is described.

646 (EPRI-CS—5361-Vol.2, pp 31.1-31.27) **Development of low level NH_3 measuring method.** Nakabayashi, Y.; Abe, R.; Izumi, T. (Electric Power Development Co., Ltd., Tokyo, Japan). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The performance of NOx reducing catalyst shall be continuously checked by measuring slip NH_3 at the downstream of SCR reactor. There are two different methods to measure low level NH_3, a so-called direct method and an indirect method. An indirect method has to use a catalyst, in order to convert NH_3 to NO. EPDC and Anritsu Corporation jointly developed the direct NH_3 measurement and applied it at Takehara #3 (700 MW) unit. This instrument detects the ultraviolet absorption of NH_3 spectrum by frequency modulation. The sampling method is also important to measure low level NH_3 (0-20 ppm). The principle of these methods is described.

647 (EPRI-CS—5361-Vol.2, pp 32.1-32.21) **Updated technical and economic review of selective catalytic NO/sub x/ reduction systems.** Damon, J.E.; Ireland, P.A.; Giovanni, D.V. (United Engineers & Constructors, Denver, CO). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

Selective Catalytic NO/sub x/ Reduction is now being used on coal-fired units in Japan, in both retrofit and new unit applications. This update lists Japanese coal-fired units using SCR. In addition, it updates the technical design requirements to help prevent air heater plugging by ammonia-sulfur compounds. The major new requirement is a lower NH_3 slip limit of 3 ppm to 5 ppm which in turn requires significantly lower space velocities. Hence greater catalyst volumes and process costs are realized than were identified 2 or 3 years ago. In addition, the impact of the devaluation of the dollar against the yen is reviewed. Current SCR cost analyses for a new utility coal-fired unit application, and retrofit utility coal-fired units are provided. The new Industrial NSPS NO/sub x/ limits are presented and an SCR cost analysis on a small industrial generator is reviewed. Finally, conclusions based on Japanese SCR experi-

ence in terms of updated costs and its present applicability to US coal-fired units are presented.

648 (EPRI-CS—5361-Vol.2, pp 33.1-33.18) **Mechanisms of fixed nitrogen reduction in pulverized coal flames.** Kramlich, J.C.; Lester, T.W.; Wendt, J.O.L. (Energy and Environmental Research Corp., Irvine, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

Although the major features that mark the conversion of coal nitrogen have been identified through extensive research, some portions of the process are not well understood. An understanding of these processes, and their associated rates, will provide the information needed to develop process models. Three areas have been identified for which present process models fail to predict the observed fixed nitrogen reduction. These include (1) the reduction in nitrogen that occurs at very short times, including devolatilization and reaction in the immediate vicinity of the coal particle, (2) nitrogen reduction in the bulk fuel-rich regions that are characteristic of staged combustion and reburning applications, and (3) fixed nitrogen reduction at the final leaning-out point. The work reported here examines these problems through a task on homogeneous kinetics, a task on NO reduction by heterogeneous media, and a task examining the overall process of fixed nitrogen reduction in direct coal combustion.

649 (EPRI-CS—5361-Vol.2, pp 34.1-34.15) **Interplay between chemistry and fluid mechanics in the oxidation of fuel nitrogen from pulverized coal.** Kruger, C.; Haussmann, G.; Krewson, S. (Stanford Univ., CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The evolution and subsequent reaction of gas-phase nitrogenous species from pulverized Montana Rosebud sub-bituminous coal have been measured in the Stanford entrained-flow reactor under uniform and well controlled conditions. Experiments have been performed at atmospheric pressure with temperatures up to 1850K and oxygen concentrations varying from zero to 15.0%. Gas-phase measurements have been made of carbon oxides, light hydrocarbons, NO, NO_2, N_2O NH_3, and HCN. Chemical and physical analyses of partly reacted coal particles provide data on the carbon and nitrogen content, porosity, and the rate of tar pyrolysis. A major focus of this research has been the role of tar in the evolution of fuel nitrogen. At high heating rates it is found that substantial quantities of tar are evolved in very short reaction times and that the pyrolysis products are rich in nitrogen. The rate of reaction of these products in and around a volatile cloud surrounding the parent coal particle controls the oxidation of fuel nitrogen. The measurements show that when the pyrolyzing coal particles are exposed to oxygen concentrations as low as 4% a significant portion of the fuel nitrogen can be oxidized to NO, although some of this NO is subsequently reduced in the gas phase.

650 (EPRI-CS—5361-Vol.2, pp 35.1-35.18) **Reduction of NO/sub x/ by fuel staging.** Toqan, M.A.; Teare, J.D.; Beer, J.M.; Radak, L.J.; Weir, A. Jr. (Massachusetts Institute of Technology, Cambridge). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

Results are reported of theoretical and experimental studies in which natural gas was used as reburn fuel for NO/sub x/ reduction in a No.6 fuel oil flame. A Sandia chemical kinetic code with kinetic parameters of hydrocarbon - NO reactions developed by J.M. Levy and B.R. Taylor at MIT was used to predict chemical species concentrations in the reburn zone as a function of residence time, initial NO concentration, gas temperature and fuel equivalence ratio (phi). The fractional reduction of high initial NO concentrations (~ 800 ppm) in the reburn stage is shown to be proportional to the concentrations of CH/sub i/ and NH/sub i/ species. At high temperatures (2000 K), the abundance of CH/sub i/ and NH/sub i/ species causes a reduction of NO from 800 ppm to 46 ppm at a phi of 1.3. At lower initial NO concentrations (~ 40 ppm), NO formation dominates over its reduction with the result that better reduction of NO is achieved at the lower temperature of 1800 K: for an initial NO concentration of 40 ppm and a phi = 1.3 the exit NO concentrations are 25 ppm and 38 ppm at 1800 K and 2000 K respectively. For a given gas temperature the CH/sub i/ radical concentration increases with increasing fuel equivalence ratio in the reburn zone and the fractional conversion of NO to N_2 as a function of phi follows the usual trend of showing an optimum at around phi = 1.3. At lower than optimal fuel equivalence ratios the NO reduction becomes strongly temperature dependent. (At phi = 1.1 calculated NO reductions are 18% at 1780 K and 60% at 2000 K). Experimental data obtained in a 1.5 MW No.6 oil flame with 400 ppm (doped) initial NO concentration at at phi = 1.1 showed good agreement with predictions.

651 (EPRI-CS—5361-Vol.2, pp 36.1-36.37) **Fuel bound nitrogen evolution during the devolatilization and pyrolysis of coals of varying rank.** Freihaut, J.D.; Proscia, W.M.; Seery, D.J. (United Technologies Research Center, East Hartford, CT). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

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The near-term use of coal for power generation involves the development of low NOx burners for retrofit applications or the design of new boiler systems. Intermediate and long-term applications propose using dry or slurried micronized coal feeds in modular, load-following high intensity combustion systems. All systems anticipate a form of stoichiometric staging of the micro-scale combustion process to obtain acceptable levels of NOx emissions. However, maximizing carbon burnout while minimizing NOx formation in these systems will require the formulation of quantitative models of the micro-scale combustion process of coals of varying rank characteristics. The complexity of the processes involved with necessitate models more empirical and phenomenological than mechanistic, but will need to take into account the significant variation in nitrogen evolution pathways with coal type. Results are presented of an investigation of the nitrogen evolution behavior of a range of coal ranks in a variety of heating conditions and the initial formulation of a kinetic model of coal nitrogen devolatilization. With respect to the total mass fraction of coal nitrogen volatilized during transient heating of particles to 1000 C, the evolution of fuel bound nitrogen appears relatively rank insensitive in moderate heating rate conditions for high volatile bituminous coals and lower ranks. The mass fraction of nitrogen evolved follows the mass fraction of coal volatilized and, under conditions where secondary reactions of tar are minimized, the distribution of parent coal nitrogen between tar and light gases follows the distribution of parent coal mass between these volatile types. The distribution of coal nitrogen in volatile types varies as the distribution of coal mass between the volatile types.

652 (EPRI-CS—5361-Vol.2, pp 37.1-37.18) **Feasibility of reburning for cyclone boiler NO/sub x/ control.** Maringo, G.J.; Acree, M.A.; Farzan, H.; McElroy, M.W. (Babcock & Wilcox Co., Barberton, OH). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The results are presented of an engineering and economic feasibility study of reburning as a potential retrofit NO/sub x/ reduction method for coal-fired cyclone boilers. Results indicate that the majority of cyclone boilers are suitable for retrofit from the standpoint of available furnace residence time, a key parameter in applying the technology. Heat transfer analysis for a 200 MW cyclone boiler case study predicts insignificant increases in furnace exit gas temperatures; thus, no convective pass or sootblowing modifications would be required. No technical factors were identified that would preclude retrofit or reburning to most of the cyclone boiler generating capacity. NO/sub x/ reductions predicted for 200 MW and 700 MW boilers were 50 and 60%, respectively, without derating. These predictions are based upon the units available furnace residence times. Capital and 10-year levelized busbar

power cost estimates ranged from $15 to $34 per kW and 1.6 to 4.0 mills per kWh, depending on the reburning fuel selected. A follow-on pilot reburning project on a 6-million Btu/hr cyclone-equipped test furnace is also described.

653 (EPRI-CS—5361-Vol.2, pp 38.1-38.20) **NO/sub x/ options for coal-fired cyclone utility boilers.** Thompson, R.E.; Himes, R.M.; Offen, G.R. (Fossil Energy Research Corp., Laguna Hills, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The implementation of stringent NO/sub x/ regulations in Japan and West Germany has increased the probability of NO/sub x/ control provisions in acid rain legislation in the US. The economic impact of this proposed legislation is a serious concern to utilities with cyclone units because they have high NO/sub x/ emissions and very few cost-effective retrofit options. An EPRI study is discussed that is directed at evaluating NO/sub x/ control options ranging from conventional and advanced combustion modifications to low-NO/sub x/ slagging combustors, reburn technology and flue gas treatment. The first phase of the study included a review of cyclone NO/sub x/ emission characteristics, their dependence on boiler design and operating parameters, and a comparison to other unit designs. Prior attempts to reduce cyclone NO/sub x/ emissions by means of combustion modifications were evaluated and constraints to low-NO/sub x/ operation identified. These design and operating constraints included reduced combustion gas temperature, slag capture and slag viscosity control, high temperature corrosion, and carbon burnout. The relative NO/sub x/ reduction potential and operating constraints of several potential retrofit NO/sub x/ control concepts were then compared on a preliminary basis to determine which concepts exhibited the most promise. A more detailed evaluation of these concepts is continuing including brief technical and economic comparisons to alternative NO/sub x/ control options for cyclone units.

654 (EPRI-CS—5361-Vol.2, pp 39.1-39.27) **TRW coal combustor: NOx emissions.** Frey, D.J. (TRW Inc., Redondo Beach, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

An atmospheric, entrained coal combustor has been developed which can either be retrofitted to existing units or integrated with new steam generating equipment. The concept consists of a water-cooled main combustor in which pulverized coal is burned in suspension at heat release rates approaching 1 mm Btu/hr-Ft^3 of combustor volume. Combustion occurs at sub-stochiometric conditions in order to control NO/sub x/ formation. More than 90% of the ash is removed from the combustor as a molten slag. The flue gas exiting the combustor is at a temperature near 3000°F, contains almost no carbon, only 10% of the ash, and CO & H_2 (amounting to about 15% of the original heat input). These gaseous combustibles must be burned in the host boiler and the final air, termed secondary air, is injected into the furnace through a conventional windbox/burner arrangement. A large number of tests have been conducted to minimize NO/sub x/ formation. Later tests were performed in a 50 mm Btu/hr combustor. These results supported most of the earlier conclusions and provided additional insight regarding the beneficial effects on NO/sub x/ formation of controlled mixing and burning in the secondary combustion stage. The results from both the 10 mm Btu/hr and 50 mm Btu/hr combustors are presented.

655 (EPRI-CS—5361-Vol.2, pp 40.1-40.12) **Methanol dual-fuel combustion.** Weir, A. Jr.; Radak, L.J.; Danko, E.A.; Lewis, R.A.; Buchanan, H.W. (Southern California Edison Co., Rosemead). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

Dual-fuel combustion is a technique invented to lower emissions of NO/sub x/ from boilers. Experimental data are presented using this technique in a utility boiler at a level of 35 megawatts. Tests with low sulfur (0.21% S) oil/natural gas, low sulfur oil/methanol, and natural gas/methanol were performed and the NO/sub x/ emissions data were compared with NO/sub x/ emissions of 100% low sulfur oil, gas, and methanol. Tests with a mixture of 70% natural gas/30% methanol revealed that the NO/sub x/ emissions level using the dual-fuel technique was lower than those obtained with either 100% gas or 100% methanol. The NO/sub x/ level was about 25% of the level obtained with natural gas fired in a conventional combustion mode or about 50% of the NO/sub x/ level obtained with natural gas fired in a staged combustion or burners out-of-service mode, a state-of-the-art combustion modification technique used to lower NO/sub x/ emissions.

656 (EPRI-CS—5361-Vol.2, pp 41.1-41.22) **Application of fuel biasing for NO/sub x/ emission reductions in gas-fired utility boilers.** Quartucy, G.C.; Mansour, M.N.; Nylander, J.H. (KVB, Inc., Irvine, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The effectiveness of fuel biasing in reducing NO/sub x/ emissions from gas-fired utility boilers has been evaluated. The unit chosen for this evaluation, South Bay Unit 1, is a 150 MW face-fired unit which currently meets local NO/sub x/ emissions limits by operating with burners-out-of-service (BOOS). This operating mode results in CO emissions of greater than 2000 ppm and an O_2 imbalance. Fuel biasing offers a reduction in NO/sub x/ emissions by controlling combustion stoichiometry in two discrete combustion stages. The first stage is operated fuel-rich in order to limit the formation of thermal NO/sub x/, while the second stage may be operated either fuel-rich or fuel-lean. The primary advantage of fuel biasing is that it provides better control of combustion stoichiometry, which serves to reduce O_2 imbalances and increased CO emissions which may accompany BOOS operation. The effect of fuel bias ratio, air register position, and excess oxygen level on unit emissions and performance were evaluated. The use of fuel biasing allowed the unit to meet local NO/sub x/ regulations, while decreasing the O_2 imbalance and reducing CO emissions to less than 500 ppm. Additionally, improvements in unit operating efficiency were measured when using the fuel biasing firing mode.

657 (EPRI-CS—5361-Vol.2, pp 42.1-42.18) **NO/sub x/ inventory and retrofit assessment.** Mormile, D.J.; Kerho, S.E.; Hunter, S.C.; Coffey, P.E. (Consolidated Edison Co. of New York, Inc., New York). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The Empire State Electric Energy Research Corp. (ESEERCO) has funded a program to develop a model for estimating NO/sub x/ emissions from the New York Power Pool (NYPP) electric system for different generation dispatch scenarios. Baseline emission levels for each boiler and for the entire system were calculated. In addition the technical feasibility, NO/sub x/ reduction potential, and costs of commercially available NO/sub x/ control technologies were evaluated for each boiler. Besides quantifying annual NO/sub x/ emission rates for NYPP fossil fuel fired power plants, the model enables ESEERCO to evaluate the effectiveness and costs of alternative NO/sub x/ reduction strategies.

658 (EPRI-CS—5361-Vol.2, pp 43.1-43.23) **Full scale evaluation of urea injection for NO removal.** Mansour, M.N.; Nahas, S.N.; Quartucy, G.C.; Nylander, J.H.; Kerry, H.A.; Radak, L.J.; Eskinazi, D.; Behrens, T.S. (Applied Utility Systems, Inc., Santa Ana, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

An engineering evaluation was performed by San Diego Gas and Electric (SDG & E) to assess the use of urea injection for NO emissions control on gas and oil fired utility boilers. This evaluation consisted of a field assessment of the technology on Unit 2 at SDG

& E Encina Generating Station and an evaluation of technology economics. The program was co-funded by Southern California Edison Company (SCE) and the Electric Power Research Institute (EPRI). Fuel Tech, Inc. (FT) co-sponsored the field assessment. The program represented the first application of the urea technology to a utility boiler. Urea injection for NO emissions control was developed in 1976 by KVB under EPRI sponsorship. It involves spraying urea as an aqueous solution into the products of combustion where the urea reacts with NO in the gas phase to produce molecular nitrogen and water. The process is dependent on combustion gas temperature with a reduction in emissions achieved between 1400°F and 2000°F.

659 (EPRI-CS—5361-Vol.2, pp 44.1-44.18) **Retrofit combustion controls for gas/oil-fired utility boilers.** Pepper, W.W.; Balingit, R.F.; Giovanni, D.V.; Teixeira, D.P. (Dept. of Water and Power, Los Angeles, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The NOx Reduction Program, a voluntary undertaking by the City of Los Angeles, Department of Water and Power (LADWP), was initiated after assessing that utility boilers in the Los Angeles Basin are becoming targets for additional NOx controls and that Rule 1135.1 NOx settlement limits may be exceeded in the future under certain dispatch and fuel use scenarios. The program is based on two objectives: (1) to implement measures that will assure continued compliance with the Rule 1135.1 NOx settlement emission limits, which could be exceeded sometime in the 1990's under certain resource scenarios such as unavailability of natural gas or hydroelectric import energy; and (2) to evaluate advanced low-NOx combustion technology capabilities systems as an alternative to postcombustion treatment for retrofit on existing low capacity factor utility boilers. Combustion controls appear to be significantly more cost effective than postcombustion treatment, and their installation could be incorporated with other compatible boiler modifications that would improve boiler reliability and thermal performance. Specific tasks performed to accomplish these objectives are discussed.

660 (EPRI-CS—5361-Vol.2, pp 45.1-45.15) **Pilot-scale tests of multistaged burner designed for low NO/sub x/ emission and high combustion efficiency.** Mulholland, J.A.; Srivastava, R.K. (Air and Energy Engineering Research Lab., Research Triangle Park, NC). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

A multistaged combustion burner design is being evaluated on a 0.6 MW package boiler simulator for in-furnace NO/sub x/ control and high combustion efficiency. An adiabatic precombustion chamber burner has been reduced insize by approximately a factor of two. Natural gas, doped with ammonia to yield a 5.8% fuel nitrogen content, was used to simulate a high nitrogen content fuel/waste mixture. A burner baseline NO emission of 315 ppm (measured dry, corrected to 0% O_2) was measured, compared with an emission of 1000 ppm estimated for a conventional, unstaged burner. Both deep air staging, resulting in a three-stage configuration, and fuel staging with undoped natural gas, yielding four stoichiometric zones, reduced the baseline NO emission by approximately 50% (to 160 ppm), meeting the program goal. However, deep air staging resulting in the entire front end of the boiler being fuel-rich and required penetrations into the boiler for staged air injection. Fuel staging, on the other hand, required no boiler penetrations (staged fuel and air were injected from the boiler front wall) and only a small fuel-rich flame core in the boiler (produced aerodynamically). Furthermore, sufficient air for complete oxidation of the primary combustion products was provided at the burner exit (prior to staged fuel and air injection into the boiler) in the fuel staging tests. Thus, the four-stage configuration appears to be the most promising approach for minimizing NO emissions and maximizing primary fuel/waste destruction. Further testing is ongoing with pyridine and fuel oil mixtures to better characterize surrogate fuel/waste destruction efficiency.

661 (EPRI-CS—5361-Vol.2, pp 46.1-46.16) **Diesel engine NO/sub x/ control: selective catalytic reduction and methanol emulsion.** Wasser, J.H.; Perry, R.B. (Air and Energy Engineering Research Lab., Research Triangle Park, NC). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

EPA's Air and Energy Engineering Research Laboratory has recently conducted two diesel engine NO/sub x/ reduction studies, one a long term test evaluation of a selective catalytic reduction (SCR) system and the other an evaluation of methanol emulsion fuel. The SCR project established the NO/sub x/ reduction performance of a catalytic unit over a 4000-hour period. NO/sub x/ reductions ranged between 98 and 69% during the test, with periodic (approximately every 1300 hours) dry cleaning required to maintain activity. Measurements of other pollutants (carbon monoxide and particulate matter) indicated that the catalyst and/or ammonia addition had no effect on these emissions. No adverse operational problems were encountered on the engine system during the test program. The methanol project established the performance of this fuel modification. The diesel system was equipped with a fuel emulsification unit capable of delivering methanol/fueloil or water/fueloil mixtures to the engine's fuel supply line. NO/sub x/ emission reductions of 20 to 25% were measured when firing methanol/fueloil emulsions compared to fueloil firing only. However, substantial increases in carbon monoxide (from 30 to 700 ppm) and hydrocarbon (from 4 to 200 ppm) emissions were also recorded. The methanol/oil emulsion results are also compared to water/oil emulsion results on the same engine.

662 (EPRI-CS—5361-Vol.2, pp 47.1-47.17) **Control of NO/sub x emissions from municipal solid waste incinerators.** Heap, M.P.; Lanier, W.S.; Seeker, W.R. (Energy and Environmental Research Corp., Irvine, CA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The disposal of municipal solid waste is a growing problem because of the declining capacity of landfills and restrictions on their use. Incineration provides a cost effective solution; the bulk of material requiring landfilling is reduced, the material can be landfilled with minimal restrictions, and the energy in the waste is converted to usable heat and/or power. Incineration cannot be accomplished without due consideration to the generation and control of atmospheric pollutants. Of major concern are trace quantities of potentially toxic hydrocarbons. The emission of these species can be minimized by appropriate design and operation of the combustion system, unfortunately these measures tend to increase rather than decrease emissions of nitrogen oxides. The types of municipal waste combustion devices and the types of pollutants generated during waste combustion are discussed. Four methods of NO/sub x/ control are discussed: (a) Combustion Zone Control; (b) selective Non-Catalytic; (c) Selective Catalytic ; and (d) Hybrid Processes.

663 (EPRI-CS—5449) **Organic coatings in simulated flue gas desulfurization environments: Final report.** Leidheiser, H. Jr.; White, M.L.; Mills, D.J. (Lehigh Univ., Bethlehem, PA (USA). Center for Surface and Coatings Research; Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 108p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920047/JAW.

Coatings prepared from the following resin systems and applied to steel were evaluated in simulated flue gas desulfurization environments: nine combinations of epoxy resin and amine hardeners, three vinyl systems, a polyester, a fluoropolymer, a urethane/asphalt and an electrostatically sprayed, fusion-bonded epoxy. The evaluation techniques used on the coatings before and after environmental exposure included: corrosion potential, AC conductance at 2 kHz, DC resistance, weight gain and tensile adhesion. The results for the nine combinations of three epoxy resins and three hardeners exposed to 0.1M H_2SO_4, and to H_2SO_4 containing other salts and adjusted to pH 0.5, showed that the hardener had more

effect on behavior than the resin; a bisphenol A and two novolac resins showed the poorest performance when hardened with a mixed aromatic/aliphatic amine, and the best performance when hardened with an aliphatic or cycloaliphatic amine. Two epoxy systems showed particularly good performance: a bisphenol A hardened with a cycloaliphatic amine and a novolac hardened with an aliphatic amine. The electrostatically applied, fusion-bonded epoxy coating showed no evidence of deterioration of the coating nor corrosion of the substrate after 5000 h exposure to 0.1M H_2SO_4. Epoxy and vinyl coatings exhibited no cracking and no corrosion in welded and non-welded areas after thermal cycling twelve times between room temperature and 100 to 120°C followed by exposure to acid. The epoxy coatings had better impact resistance after thermal cycling than the vinyl coatings. 15 refs., 20 figs., 23 tabs.

664 (KFK-PEF—12-Vol.2, pp 521-533) **Dry limestone and dolomite flue gas desulfurization: Improvement of sulfur dioxide sorption by optimum pore structure, by pelletizing and by chemical activation of the sorbent.** Weisweiler, W.; Hoffmann, R.; Stein, R. (Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Chemische Technik). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The present stage of research for improvement of sulfur dioxide sorption with lime products has been to optimate the pore structure by varying the conditions cf calcination and by pelletizing of dolomite and limestone. Another two potential ways to improve the degree of sulfation are soaking the raw material with solutions of activating salts and hydrating lime.

665 (KFK-PEF—12-Vol.2, pp 535-547) **Development of techniques for the combined removal of dusts and gaseous pollutants: 'Kinetics of the gas-solid reactions'.** Hedden; Balekdjian, O. (Karlsruhe Univ., T.H., Germany, F.R. Engler-Bunte-Institut Bereich 1 - Gas, Erdoel und Kohle). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

For the development of a technique based on the removal of acid pollutant gases by addition of alkaline dusts at high temperatures the kinetics of the reactions of HCl and SO/sub 2/ with CaO- and Ca(OH)/sub 2/-dusts ($d < 50$ μm) was investigated. The experiments showed that under the same experimental conditions (temperature, residence time, particle size, gas composition) Ca(OH)/sub 2/ has a greater absorption capacity for hydrogen chloride and sulphur dioxide than CaO. The optimum temperature for the removal of HCl is 400/sup 0/C. Sintering or melting of CaCl/sub 2/, which is produced during the removal of HCl, is the reason for the decrease of the absorption capacity at 600 or 800/sup 0/C.

666 (KFK-PEF—12-Vol.2, pp 549-563) **Optimization of high-temperature particle separation in connection with gas-sorption.** Loeffler, F.; Gaeng, P. (Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Mechanische Verfahrenstechnik und Mechanik). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

During the course of filtration with fabric filters (e.g. bag filters), a so-called cake forms upon the surface of the filter. With progressive filtration, this cake rapidly becomes the actual filtermedium, retaining particles over the complete size-range for which such filters are renowned. Under favorable conditions (e.g. adequate temperatures and residence time) this cake may also serve to separate gaseous pollutants such as SO/sub 2//SO/sub 3/, HCl and HF. Here, the extremely porous filter cake ($\epsilon \approx 0.8$) serves as a reactor for a gas-solid reaction with fine-particle alkaline sorbents (e.g. CaO, Ca(OH)/sub 2/, etc.). This project is aimed at investigating high-temperature filtration with fabric filters in the temperature-range up to 600/sup 0/C under consideration of gas sorption within the filter cake.

667 (KFK-PEF—12-Vol.2, pp 565-578) **Development of an agglomerator for the elimination of flue gas aerosols.** Backhaus, A.; Conrads, M.; Wurz, D. (Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Technische Thermodynamik). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The elimination of aerosols contained in flue gases downstream of flue gas cleaning units is often connected with a very high consumption of energy or with a decrease of the elimination rate for fine particles. This paper deals with a new agglomerator system for the elimination of flue gas aerosols. After the flue gas aerosols have settled down on a fine wash liquid spray, the agglomerator transforms this spray into coarser droplets, which can easily be eliminated by common drift eliminators.

668 (KFK-PEF—12-Vol.2, pp 579-589) **Optimization of catalyst composition for selective catalytic reduction of nitrogen oxides by ammonia under transient conditions.** Kotter, M.; Lintz, H.G. (Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Chemische Verfahrenstechnik). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The impregnation type catalysts used contain V/sub 2/O/sub 5/ and TiO/sub 2/ as active components. After an adequate pretreatment they show a reduced activity in the SO/sub 2/-oxidation. This reduction is achieved by a treatment in an ammoniacal solution. Additionally the pretreatment improves the catalyst characteristics during the time on stream.

669 (KFK-PEF—12-Vol.2, pp 627-635) **Denitrification and desulfurization of flue gas by Corona discharge.** Stocker, K.E.; Weiss, H.R.; Bloss, W.H. (Stuttgart Univ., Germany, F.R. Inst. fuer Physikalische Elektronik). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The 'Korona-Verfahren' (CDDS Corona Discharge Dry Scrubber) is expected to remove SO/sub 2/ and NO/sub x/ from flue gas by electrical discharges in a simultaneously and dry scrubbing process. In the corona discharge electrons are energized, which are able to form radicals (O, OH, O/sub 2/H etc.) among other excited molecules. The oxidation of NO/sub x/ and SO/sub 2/ yields the corresponding acids H/sub 2/SO/sub 4/ and HNO/sub 3/. These acids are neutralized by NH/sub 3/, producing ammonium salts, which can be removed by filtration. First results of the research show a high reduction of nitrogen oxides.

670 **(PB—87-217741/XAB) Sulfur dioxide emission projections for Maryland utilities 2000-2030. Final report.** (Environmental Resources Management, Inc., West Chester, PA (USA)). May 1987. 73p. NTIS, PC A04/MF A01.

The purpose of the report is to project sulfur dioxide emissions from Maryland electric utilities for the years 2000-2030. Sulfur dioxide emissions data for 1980-1985 and projections from Maryland utilities through 2000 were obtained from state agencies and Maryland utility companies. Various assumptions of energy sales growth, future sulfur dioxide emissions rates, and generating-unit retirement ages were used. Emissions are projected to increase through about 2015-2020, then decline to about the present level.

2003 Power Transmission And Distribution

671 **(AD-A—182476/2/XAB) Novel concept for the rapid deployment of electric power cables. Phase 1. Final report, 29 September 1986-30 April 1987.** Callahan, T.F. (University Research Engineers and Associates, Inc., Hercules, CA (USA)). 30 Apr 1987. 93p. NTIS, PC A05/MF A01.

The report covers the research & analysis required to establish the feasibility of a concept to design and demonstrate a system for rapidly deploying and retrieving electric-power cables by launching the cables through the air. The TOW missile is the optimum deployment vehicle for transporting one end of the cable toward the tactical position that requires power. The approach effectively neutralizes both man-made and naturally occurring deployment obstacles, e.g. nuclear, biological chemical environment, combat zone, impassable topography (deep ravine, steep cliff, etc.), open hostile areas (marshes, lakes, and rivers). The deployment range is estimated to be 500 to 1000 ft. The retrieval can be accomplished by a robotic device that automatically cleans, disconnects, coils, packages and covers fifty-foot lengths of cable.

672 **(AD-A—182477/0/XAB) Cable and cable dynamics analysis of CSSSRNM (combined surface ship and submarine radiated noise measurement) array installation, Nanakuli, Hawaii. Final report.** (Western Instruments Corp., Oxnard, CA (USA)). Apr 1987. 26p. NTIS, PC A03/MF A01.

The statement of work for this project lists three primary tasks. The first task is to determine and confirm the mechanical parameters of the specified cable and and armor package. The maximum tension loading and bend diameters that the cable will withstand without failure is also to be calculated. The task shall also recommend and confirm safe working loads for cable handling. The second task in the statement of work is to simulate the cable-laying operation. A dynamic cable analysis program such as SEADYN, is to be used in the time domain to determine the maximum loads expected on the cable during installation. The two primary points of interest in this analysis consist of (1) the loading on the Sea Cable as it supports the double armored Shore Cable in the water column, and (2) the installation procedures and configurations to prevent undue loading on the cable during the entire operation. The third task consists of recommending the maximum tension and ship velocity as a function of time, while laying the cable over the escarpment and on the downslope portion of the cable-laying operation.

673 **(DOE/RG—0069) Electricity transactions across international borders, 1986.** (USDOE Economic Regulatory Administration, Washington, DC. Office of Fuels Programs). Oct 1987. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000915/JAW.

This report summarizes the electricity exchanges between the United States and Mexico and Canada during Calendar Year 1986. The construction, connection, operation and maintenance of any electric transmission facility which crosses an international border of the United States requires a Presidential permit. Presidential permits require that an annual report be filed by the permit holder detailing all transactions with the foreign country. 3 figs., 3 tabs.

674 **(EPRI-EL—5255) Evaluation of improvements in the installation of rural underground transmission lines: Final report.** Ziegler, A.; Lee, R.A.S. (Foster-Miller, Inc., Waltham, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 87p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920043/JAW.

This report presents the results of an investigation into currently used methods for installation of underground high voltage power transmission cable, and offers recommendations for potentially improving these methods. Suggested enhancements cover the emplacement of both high pressure oil filled (HPOPT) pipe type and self contained oil filled (SCOF) cable systems. Cost comparisons of conventionally installed cable systems versus systems using proposed techniques and equipment are developed for a specific site selected for study. The report also documents the test results of laboratory experiments conducted to demonstrate the feasibility of using interference fit pipe couplings in place of welded pipe joints. 10 refs., 31 figs., 15 tabs.

675 **(EPRI-EL—5257) Economic study of a rural underground transmission system: A site-specific case study: Final report.** Sheridan, R.; Garrity, T.F. (Main (Charles T.), Inc., Boston, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 78p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920050/JAW.

This report presents the data and results of a site specific case study comparing costs of an overhead line with an underground circuit traversing the same route. The costs used for the overhead line are actual numbers for a line scheduled to be built by a utility. The underground circuit costs were developed using the same criteria of line rating, contingencies, and location. Often cost comparisons between overhead and underground lines are made using figures taken from studies with widely varying assumptions. This project attempts to provide a comparison by studying the costs of overhead and underground lines following the same route and using the same design assumptions. Caution must be used, however, in extending the results of this study beyond its original intent. It is site-specific and may be representative of only one area of the country. 9 refs., 23 figs., 18 tabs.

676 **(EPRI-EL—5323) Experimental study of the undrained uplift behavior of drilled shaft foundations: Final report.** Beech, J.F.; Kulhawy, F.H. (Cornell Univ., Ithaca, NY (USA). Geotechnial Engineering Group; Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 336p. Research Reports Center, Box 50490, Palo Alto CA 94303. Order Number TI88920053/JAW.

An experimental study was conducted to evaluate the behavior of drilled shaft foundations subjected to undrained uplift loads. Tests were conducted on model shafts constructed in both large-scale and small-scale soil deposits. The small-scale models were constructed in 55 gallon drums, and the soils were prepared at a number of stress histories ranging from normally consolidated to heavily overconsolidated. The test shafts had dimensions of 89 mm (3.5 in.) diameter and 457 mm (18 in.) length. The large-scale models were constructed in a 2.1 m (7.0 ft) diameter and 2.9 m (9.5 ft) deep test pit and ranged in size from 89 to 305 mm (3.5 to 12 in.) diameter and 610 to 1220 mm (2 to 4 ft) long. Instrumentation used included butt load and displacement, soil stress, and soil pore water stress. Factors influencing shaft capacity examined were: in-situ state of stress, stress changes during construction, construction method, and moisture migration. From the test results and the analyses conducted, a consistent pattern of behavior emerged, which led to an effective stress design method for capacity, load transfer, and movement evaluation. Several case studies were used to illustrate the method and good correlation was observed, except in heavily overconsolidated soils which fail by cone breakout, a mode not included in the method. This newly developed method provides a rational framework for the effective stress analysis and design of drilled shafts in undrained uplift loading. 23 refs., 18 figs., 22 tabs.

677 **(PB—87-212536/XAB) Limits to the precision of electro-optic and magneto-optic sensors. Technical note.** Day, G.W.; Hale, P.D.; Deeter, M.; Milner, T.E.; Conrad, D. (National Bureau of Standards, Boulder, CO (USA). Electromagnetic Technology Div.). Mar 1987. 123p. (NBS/TN—1307). NTIS, PC A06/MF A01.

Also available from Supt. of Docs as SN003-003-02801-1.

The principles of electro-optic and magneto-optic sensors suitable for use in power-system applications are reviewed with particular attention to the properties of materials and components that limit the precision of such sensors. Data on a number of materials are collected and presented. For high-precision electro-optic sensors, it is recommended that crystals of point symmetry (bar 4)3m be used. For high-precision magneto-optic sensors, a lead glass with a low stress-optic coefficient is recommended. Choices for other components are also suggested. For both types of sensors, a precision of roughly plus or minus 1 percent over a 100 C temperature range should be attainable. To achieve a precision better than that, it will be necessary to use temperature compensation techniques, several of which are proposed and discussed.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 2754

678 (NEI-FI—1, pp 4.3.1-4.3.12) **Applications of a new reliability growth model that fits data.** Vaurio, J.K.; Isaksson, J.; Linden, U. (Imatran Voima Oy, Loviisa, Finland. Loviisa Power Station). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

A new predictive reliability growth model is developed based on the rationel that learning is due to failure events, rather than passage of time. A practicable moment matching technique is presented for estimating the parameters of the model. Several applications are presented, demonstrating a broad validity of the model.

679 **(NUREG—0020-Vol.11-No.3) Licensed operating reactors: Status summary report, Data as of 2-28-87.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Information Resources Management). Oct 1987. 455p. NTIS, PC A20/MF A01 - GPO. Order Number DE88900068/JAW.

The Operating Units Status Report- Licensed Operating Reactors provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Administration and Resources Management from the Headquarters staff of NRC's Office of Enforcement (OE), from NRC's Regional Offices, and from utilities. The three sections of the report are: monthly highlights and statistics for commercial operating units, and errata from previously reported data; a compilation of detailed information on each unit, provided by NRC's Regional Offices, OE Headquarters and the utilities; and an appendix for miscellaneous information such as spent fuel storage capability, reactor-years of experience and non-power reactors in the US. It is hoped the report is helpful to all agencies and individuals interested in maintaining an awareness of the US energy situation as a whole.

680 **(NUREG—0020-Vol.11-No.4) Licensed operating reactors: Status summary report data as of 3-31-87.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Information Resources Management). Oct 1987. 501p. NTIS, PC A22/MF A01 - GPO. Order Number DE88900088/JAW.

The Operating Units Status Report - Licensed Operating Reactors provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Administration and Resources Management from the Headquarters staff of NRC's Office of Enforcement (OE), from NRC's Regional Offices, and from utilities. The three sections of the report are: monthly highlights and statistics for commercial operating units, and errata from previously reported data; a compilation of detailed information on each unit, provided by NRC's Regional Offices, OE Headquarters and the utilities; and an appendix for miscellaneous information such as spent fuel storage capability, reactor-years of experience and non-power reactors in the US. It is hoped the report is helpful to all agencies and individuals interested in maintaining an awareness of the US energy situation as a whole.

681 **(NUREG—0020-Vol.11-No.5) Licensed operating reactors: Status summary report, Data as of April 30, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Information Resources Management). Oct 1987. 493p. NTIS, PC A21/MF A01 - GPO. Order Number DE88900093/JAW.

The operating units status report - licensed operating reactors provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Administration and Resources Management from the Headquarters staff of NRC's Office of Enforcement (DOE), from NRC's Regional Offices, and from utilities. The three sections of the report are: monthly highlights and statistics for commercial operating units, and errata from previously reported data; a compilation of detailed information on each unit, provided by NRC's Regional Offices, DOE Headquarters and the utilities; and an appendix for miscellaneous information such as spent fuel storage capability, reactor-years of experience and nonpower reactors in the US. It is hoped the report is helpful to all agencies and individuals interested in maintaining an awareness of the US energy situation as a whole.

682 **(NUREG—0020-Vol.11-No.6) Licensed operating reactors: Status summary report, Data as of May 31, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Information Resources Management). Oct 1987. 473p. NTIS, PC A20/MF A01 - GPO. Order Number DE88900094/JAW.

The OPERATING UNITS STATUS REPORT - LICENSED OPERATING REACTORS provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Administration and Resources Management from the Headquarters staff of NRC's Office of Enforcement (OE), from NRC's Regional Offices, and from utilities. The three sections of the report are: monthly highlights and statistics for commercial operating units, and errata from previously reported data; a compilation of detailed information on each unit, provided by NRC's Regional Offices, OE Headquarters and the utilities; and an appendix for miscellaneous information such as spent fuel storage capability, reactor-years of experience and nonpower reactors in the US. It is hoped the report is helpful to all agencies and individuals interested in maintaining an awareness of the US energy situation as a whole.

683 **(NUREG—0020-Vol.11-No.8) Licensed operating reactors: Status summary report, Data as of July 31, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Information Resources Management). Oct 1987. 515p. NTIS, PC A22/MF A01 - GPO. Order Number DE88900100/JAW.

The Operating Units Status Report - Licensed Operating Reactors provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Administration and Resources Management from the Headquarters staff of NRC's Office of Enforcement (OE), from NRC's Regional Offices, and from utilities. The three sections of the report are: monthly highlights and statistics for commercial operating units, and errata from previously reported data; a compilation of detailed information on each unit, provided by NRC's Regional Offices, OE Headquarters and the utilities; and an appendix for miscellaneous information such as spent fuel storage capability, reactor-years of experience and non-power reactors in the US. It is hoped the report is helpful to all agencies and individuals interested in maintaining an awareness of the US energy situation as a whole.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 776, 825, 826, 828, 830, 833, 834, 835, 836, 861, 864, 886, 887, 895, 896, 897, 907, 910, 1501

684 **(EPRI-NP—5283-SR-A) Guidelines for permanent BWR [boiling water reactor] hydrogen water chemistry installations: 1987 revision: Special report.** (BWR Owners Group for IGSCC Research (USA). Hydrogen Installation Subcommittee; Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 127p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920040/JAW.

The Boiling Water Reactor (BWR) Owner's Groups initially submitted the draft "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations" to the Director, NRC Office of Nuclear Reactor Regulation (NRR) on October 12, 1985. This staff's initial review indicated that the storage and use of large quantities of liquid hydrogen on a plant size raises the concern of potentially new and different accidents from those previously considered and evaluated as part of the facility licensing process. A revised version of the "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations" was submitted to NRC for review (Neils, January 27, 1986), and the staff requested additional information concerning review of this submittal (Hulman, May 8, 1986). Another revision of the Guidelines (hereafter referred to as the Guidelines) incorporating responses to the staff's request for additional information was

submitted (Neils, December 5, 1986) and is the basis for the review. The electrolytic option that generates hydrogen and oxygen at the rate used in the process is not considered a storage option. Therefore, this report addresses liquid and gaseous hydrogen and liquid oxygen storage options and the electrolytic option.

685 **(EPRI-NP—5429M) Nickel chromium iron alloys for nuclear reactor vessel components: Final report.** Hayner, G.O.; Ballinger, R.G. (Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 45p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920048/JAW.

This report describes the work that was performed in the following areas: a survey of domestic and some foreign commercial facilities to identify and characterize nuclear power plant components fabricated from age-hardenable Alloys X-750, A-286 and 718; a more detailed characterization and examination of Alloy X-750 fuel assembly holddown spring components that failed during service in a pressurized water reactor (PWR). The results include information such as material heat treatments, operational stress levels, service temperatures, environments, extent of use and performance histories for components in service in PWR and boiling water reactor (BWR) plants. The examination performed on the fuel assembly holddown spring components includes detailed fractographic, metallographic, and microchemical characterization to determine the influence of component processing, applied stress, and design on the failure mechanism. The results obtained indicated that all failures examined were initiated by fatigue and propagated by a combination of mechanisms. Fatigue initiation is believed to occur during normal operation at full power. Surface wear and fretting directly contributed to initiation in several components examined. 26 refs., 1 fig., 8 tabs.

686 **(EPRI-NP—5461) Component life estimation: LWR [light water reactor] structural materials degradation mechanisms.** Copeland, J.F.; Gerber, T.L.; Giannuzzi, A.J.; Licina, G.J.; Pitcairn, D.R.; Riccardella, P.C. (Structural Integrity Associates, San Jose, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 181p. Research Repts. Ctr., Box 50490, Palo Alto, CA 94303. Order Number TI88920042/JAW.

As an integral part of the EPRI nuclear plant life extension (NUPLEX) and other research programs, as well as other materials studies over the last decades, an understanding of materials degradation mechanisms has been gained. The phenomenological understanding of these degradation mechanisms which potentially act on the structural materials used in construction of a light water reactor (LWR), is the first step in any analysis effort to allow utilities to meaningfully predict the useful or residual life of a component. This report serves as a sourcebook for NUPLEX studies relating to materials degradation and component longevity assessment. A comprehensive list of materials degradation mechanisms is presented in the Appendices to the report. The degradation mechanisms for both operation and shutdown are identified in terms of checklists or applicability guides for the major LWR structural materials.

687 **(INIS-mf—10980) Nuclear power plant Dodewaard (Netherlands) during 1985.** (Gemeenschappelijke Kernenergiecentrale Nederland N.V., Arnhem). 1986. 19p. (In Dutch). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703568/JAW.

An account is given of the operation of the nuclear power plant during 1985. Some special aspects concerning the operation and maintenance are brought into attention. Studies and investigations are reported on reactor fuel, fuel cycle, reactor-pressure control, vessel steels and reactor stability. Also new developments concerning measurement of waterlevel in the reactor vessel are reported. (Auth.). 9 figs.; 2 tabs.

688 **(JAERI-M—87-077) Studies on ductile unstable fracture of piping materials in light water reactors. 3. Fracture behavior of through-wall or part-through cracked tension specimens machined from 24-inch diameter carbon steel pipe at room temperature.** Onizawa, Kunio; Shibata, Katsuyuki; Yasuda, Yuji; Ohba, Toshihiro; Kawamura, Takaichi; Miyazono, Shohachiro. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 95p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750052/JAW.

LWR pressure boundary piping shall be designed considering the dynamic effect of postulated double-ended guillotine break (DEGB). However, the DEGB accident is extremely unlikely, so that leak before break (LBB) concept instead has been introduced in some countries in which nuclear power electricity is being generated. At JAERI, ductile fracture tests of stainless and carbon steel pipes have been conducted in order to verify LBB concept in the pressure boundary piping since 1983. In addition, the tests for piping material characterization have been carried out since 1984 using center cracked tension (CCT) specimen. This report summarizes stable and unstable ductile fracture test results of CCT specimens, which contain a through-wall or part-through crack, machined from 24-inch diameter STS42 carbon steel pipe. In order to characterize the material, the tearing instability criterion based on J-integral was applied to through-wall CCT specimen and the net-section collapse criterion was applied to both through-wall and part-through CCT specimens. The validity of two criteria was discussed considering LBB concept.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 685, 686, 688, 775, 784, 786, 787, 825, 827, 828, 829, 830, 833, 835, 836, 837, 838, 840, 843, 847, 848, 849, 854, 855, 863, 864, 867, 873, 875, 886, 892, 896, 897, 900, 907, 908, 910, 913, 914, 915, 918, 923, 924, 925, 1493, 1505, 1751, 2705, 2780

689 **(CEA-CONF—8880) New generation of French ISIM.** Besse, J.; Cattiaux, G.; Clicques, J.; Landez, J.P.; Birac, A.M.; Benoist, P.; Viard, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Nov 1986. 8p. (CONF-8611147—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752922/JAW.

From 8. international conference on NDE in the nuclear industry; Orlando, FL, USA (17 Nov 1986).

Up to now, 110 pre- or inservice inspections of PWR vessels have been performed both in France and aboard by the mean of the first generation of french ISIM named MIS. Due to the increase of the number inspections which have to be realized in the next years, a new generation of ISIM have been developed. The first one is named MIS 5. The general structure of the mechanical part of MIS has not been changed, some improvements have been introduced to take in account the experience and facilitate maintenance, mounting, dismounting and transportation. The main changes lie in the control system and data acquisition and analysis equipment. The versatility of computers is widely used. A parametrizing unit allows to set all the parameters both for the tools and for the ultrasonic equipment and the data acquisition system. The ultrasonic equipment is able of managing 32 channels. Data are recorded simultaneously on Winchester disk, bulk memory and cassette of a HP 1000 computer (serial 900) and cassette. SOFTWARES have been developed by INTERCONTROLE for acquisition and analysis which allow to exhibit results automatically on screen printer or/ and plotter. All the electronics and computer equipment are set in a shelter outside of the containement, linked to the MIS by 2 cables. 7 references.

690 **(CEA-CONF—8881) Joint program of ultrasonic testing of austenitic materials and welds.** Bodson, F.; Billet, M.; Coquillay, J.; Samman, J.; Serre, M.; Ratoni, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Nov 1986. 3p. (CONF-8611147—3-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752923/JAW.

From 8. international conference on NDE in the nuclear industry; Orlando, FL, USA (17 Nov 1986).

601 (CEA-CONF—8882) Ultrasonic examination of defects close to the outer surface. Benoist, P.; Serre, M.; Champigny, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Nov 1986. 5p. (CONF-8611147—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752924/JAW.

From 8. international conference on NDE in the nuclear industry; Orlando, FL, USA (17 Nov 1986).

During the examination of a pressurized water reactor vessel with an in Service Inspection Machine (MIS), various welds are scanned with immersion ultrasonic focused transducers from the inside of the vessel. Defects close to the outer surface are sometimes detected, and sizing with the successive 6 dB drop method leads to oversize some indications; this is caused by various reflections on the outer wall; the corner echo is of particular importance here. CEA and EDF have started an experimental program in order to study the response of volumetric and planar defects located near the outer surface. We present here the first results obtained with artificial defects. 2 references.

602 (CEA-CONF—8886) Experimental program of neutronphysics for advanced water reactors. Martin-Deider, L.; Cathalu, S.; Santamarina, A.; Gomit, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. des Reacteurs a Eau). Nov 1985. 25p. (In French). (CONF-8511248—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752926/JAW.

From Meeting on recent trends in the development of primary circuit technology; Madrid, Spain (25 Nov 1985).

The C.E.A. and E.D.F. has jointly undertaken a program of experimental studies on under-moderated water lattices, with mixed oxide fuel UO_2-PuO_2. Undermoderated lattices offer high conversion ratios. This type of lattice could limit in the future the natural uranium consumption of pressurized water reactors. This experimental program is aimed at qualifying neutron transport calculations in a large range of moderating ratio (between 0.5 and 1.5). It includes three experiments: ERASME, a critical experiment of large size in the EOLE reactor at Cadarache; ICARE, an irradiation experiment in the MELUSINE reactor at Grenoble; and an experiment to measure the reactivity effects by oscillations in the MINERVE reactor at Cadarache.

603 (CEGB-TPRD/B—0645/R86) Assessment of effect of dissolved species on stable droplet sizes in PWR containments post fault. Longworth, J.P. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752938/JAW.

The stability of the size distribution of water droplets suspended in the containment atmosphere arising from the fine balance between the raising of the water vapour pressure above a curved surface and its lowering due to the presence of dissolved species is considered. A model for predicting the stable size is developed from established physico-chemical theory and illustrated by application to a case where the suspended aerosol arises from fragmentation of a flashing water jet. Consideration is also given to the possible impact kinetic effects may have on the droplet behaviour.

604 (CEGB-TPRD/B—0878/R86) Review of pH calculation and corrosion product solubilities under PWR primary coolant chemistry conditions. Thornton, E.W.; Polley, M.V. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Dec 1986. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752939/JAW.

The calculation of high temperature pH in boric acid solutions is discussed and various relationships for the ionisation constant Ksub(w) or ion product Qsub(w) for water are reviewed. It is shown that the boric acid equilibria of Mesmer, Baes and Sweeton remain virtually unaltered when Marshall and Franck's relationship for Ksub(w) is substituted in a re-analysis of Mesmer, Baes and Sweeton's original experimental data. Magnetite solubility data and Westinghouse's studies of iron, nickel and cobalt solubility from mixed ferrites are collated and consideration is given to experimental difficulties which could have contributed to the variability in the data. Thermodynamic model fits have been computerised and used to compare different studies and to determine pH values at which the temperature dependence of solubility is predicted to be zero. Consideration is given to the differing dependences of solubility on dissolved hydrogen concentration in the three model fits. Two models for predicting iron and nickel solubility with respect to non-stoichiometric nickel ferrites are briefly discussed showing that only one of these is likely to be credible.

605 (CNEN-DR-GAN—01/87) Sensitivity analysis of FRAPCON-1 computer code to some parameters. Chia, C.T.; Silva, C.F. da. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). May 1987. 44p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703680/JAW.

A sensibility study of the code FRAPCON-1 was done for the following inout data: number of axial nodes, number of time steps and the axial power shape. Their influence in the code response concerning to the fuel center line temperature, stored energy, internal gas pressure, clad hoop strain and gap width were analyzed. The number of axial nodes has little influence, but care must be taken in the choice of the power axial profile and the time step length.

606 (CONF-871101—5-Summ.) Evaluation of the ^{252}Cf-source-driven neutron noise analysis method for measuring the subcriticality of LWR fuel storage casks. Mihalczo, J.T. (Oak Ridge National Lab., TN (USA)). 15 Nov 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87011112/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

The ^{252}Cf-source-driven neutron noise analysis method was evaluated to determine if it could be used to measure the subcriticality of storage casks of burnt LWR fuel submerged in fuel storage pools, fully loaded and as they are being loaded. The motivation for this evaluation was that measurements of k/sub eff/ would provide the parameter most directly related to the criticality safety of storage cask configurations of LWR fuel and could allow proper credit for fuel burnup without reliance on calculations. This in turn could lead to more cost-effective cask designs. Evaluation of the method for this application was based on (1) experiments already completed at a critical experiments facility using arrays of PWR fuel pins typical of the size of storage cask configurations, (2) the existence of neutron detectors that can function in shipping cask environments, and (3) the ability to construct ionization chambers containing ^{252}Cf of adequate intensity for these measurements. These three considerations are discussed.

607 (EPRI-NP—5406) Electrochemical corrosion of Alloy 600 in secondary water: Final report. Jones, D.A. (Nevada Univ., Reno (USA). Dept. of Chemical and Metallurgical Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 40p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920037/JAW.

Electrochemical polarization measurements were conducted on Alloy 600 to screen the corrosive effects of certain PWR secondary water contaminants. These contaminants originate from resin polishing beds, condenser leakage, makeup water, and intentional additions. All additions to AVT water increased the anodic currents, but none produced any evidence of intergranular attack as determined by microscopic examination of metallographic sections after anodic polarization. Current increases were not proportional to potential changes and consequently could not be ascribed to increases in solution conductivity. Carboxylates, fluoride and bisulfate showed uniform attack. Additions of the Zn^{++} cation did not cause any significant increase in anodic current over that of the accompanying acetate anion or produce any localized corrosion. Sulfate and benzosulfonate were found to cause irregular attack after anodic polarization which was changed to uniform attack in the presence of borate inhibitor. However, the anodic currents were not appreciably reduced in the presence of borate, and a strong inhibiting

effect was therefore not indicated. This does not preclude the possibility of inhibition of carbon steel in tubesheet crevices with alkaline solutions. 9 refs., 15 figs., 2 tabs.

698 **(FRNC-TH—2851) Contribution to the qualification of calculation methods of reactivity and of flux and power distributions in nuclear pressurized water reactor cores.** Abit, K. (Strasbourg-1 Univ., 67 (France)). 1984. 333p. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE87752740/JAW.

The last stage of the creation computer methods and calculations consists of verifying the running and qualifying the results obtained. The work of the present thesis consisted of improving a coupling method between radial and axial phenomena in a PWR core, refering to three-dimensional calculations, while ensuring a perfect coherence between the programmed physical models. The calculation results have been compared to measurements of reactivity and of flux distributions realized during start-up tests. Thus, the methods have been applied to the calculation of the evolution of a burnable poison (gadolinium) in view of operation in long campaign. 13 refs.

699 **(FRNC-TH—2928) Contribution to the development and the qualification of a calculation method for the management of PWR reactors, by means of the system NEPTUNE. Fessenheim-2 follow-up.** Kamha, E. (Paris-11 Univ., 91 - Orsay (France)). May 1981. 277p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE87752744/JAW.

The aim of this study is the definition, from the NEPTUNE code system, of a neutron calculation scheme for the follow-up of pressurized water power reactors and its application to the Fessenheim-2 follow-up. First, a description of the Fessenheim reactor core and of the fission chamber which have been used for the measurements of activity in the instrumented assemblies is given, and some theoretical points on the codes and calculation methods are recalled. Then, one presents a sensitivity analysis for the choice of a calculation scheme and the calculation of an activity map of the new core without evolution. The results needed to analyze the first cycle are given. These results are obtained after the calculation of evolution using the evolutive variation-data collections, which allow to take into account feedback (Doppler effect, due to the fuel temperature variation, and effect due to the moderator temperature variation). Finally, the calculation results of the beginning of the second cycle are given.

700 **(INIS-mf—10845) WWER-440 simulator.** (ORGREZ, Prague (Czechoslovakia)). 1985. vp. (In Czech). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87780115/JAW.

Reactor simulators for WWER-400 nuclear power plants have been constructed and a program of training has been implemented. The schedule for construction is presented. The mathematical models used to construct the simulator is related to the electronic modules of which it is constructed. Four articles present the computer system and software that provide real-time feedback to the trainee. Two articles describe the relationships between training, retraining, and economic return.

701 **(INIS-mf—10959) Tests of cooling water pumps at Dukovany nuclear power plant.** Travnicek, J. (International Atomic Energy Agency, Vienna (Austria)). 1986. 4p. (In Czech). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703556/JAW.

Tests were performed to examine the operating conditions of the 1600 BQDV cooling pumps of the main coolant circuit of unit 1 of the Dukovany nuclear power plant. For the pumps, the performance was tested in the permissible operating range, points were measured below this range and the guaranteed operating point was verified. Pump efficiency was calculated from the measured values. The discussion of the measurement of parameters has not yet been finished because the obtained values of the amount delivered and thus of the pump efficiency were not up to expectation in all detail. It was also found that for obtaining the guaranteed flow the pump impeller had to be opened to 5deg -5.5deg instead of the declared 3deg. Also tested were pump transients, including the start of the pump, its stop, the operation and failure of one of the two pumps. In these tests, pressures were also measured at the inlet and the outlet of the inner part of the TG 11 turbine condenser. It was shown that the time course and the pressure course of the processes were acceptable. In addition to these tests, pressure losses in the condenser and the cooling water flow through the feed pump electromotor cooler wre tested for the case of a failure of one of the two pumps. (E.S.).

702 (INIS-mf—11029, pp 63-71) **Effect of nuclear reactor environment on thermoelectric sensor readings.** Kotrc, S.; Skrivan, A. (Skoda, Plzen, Czechoslovakia. Zavod Energeticke Strojirenstvi). 1986. (In Czech). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700236/JAW. (CONF-8605302—).

From National conference on temperature metrology; Hradec Kralove, Czechoslovakia (19 May 1986).

The causes are discussed of additional errors in the measurement of temperatures by radiation heating of the material of the measuring junction of the thermoelectric sensor, and the importance of the magnitude of this error in determining the correction of the data of the sensor's measuring loop. An experiment is described which was conducted in water medium of the vertical channel of the WWR-S reactor. The recorded data show that the error reaches 1 degC. (J.B.).

703 (INIS-mf—11029, pp 116-121) **Calibration of temperature sensors in a nuclear reactor.** Rosenkranz, J.; Jakes, D. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1986. (In Czech). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700236/JAW. (CONF-8605302—).

From National conference on temperature metrology; Hradec Kralove, Czechoslovakia (19 May 1986).

In trial runs, 8 ion thermometric detectors were placed in the dry channel of the WWR-S reactor. The dependences were measured of the real component of their reciprocal impendance value on temperature. The measurements were conducted using a K type thermocouple. On the basis of the results of the tests, the design of the ion thermometric detectors was modified such as to make them applicable for calibrating thermometers in the nuclear reactor core. The error is estimated at +-1.5 degC and it is assumed that it is mostly caused by inaccuracies of the reference K type thermocouples.

704 **(JAERI-M—86-184) Cross flow resistance in air-water two-phase flow in rod bundle.** Iwamura, Takamichi; Adachi, Hiromichi; Sobajima, Makoto. (Japan Atomic Energy Research Inst., Tokyo). Jan 1987. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703611/JAW.

In order to evaluate the cross flow rate during the reflood phase of a PWR-LOCA, a cross flow resistance of fuel rod bundle was experimentally obtained in an air-water two-phase flow in a rod bundle. The experimental ranges are: cross flow velocity at the gap between rods at the inlet and outlet sides of the bundle 0.224 - 2.99 m/s, vertical superficial water velocity 0.025 - 0.248 m/s, and void fraction 0 - 0.34. The air cross flow rate was small in comparison to the air up-flow rate. The cross flow resistance in the two-phase flow was much higher than that in a single-phase water flow. The cross flow resistance increased with the void fraction and decreased with the cross flow velocity up to a certain void fraction (critical void fraction). A correlation of the cross flow resistance was proposed for the void fraction range below the critical void fraction as a function of the void fraction and the cross flow Reynolds number. The critical void fraction increased with the cross flow and vertical water velocity. Above the critical void fraction, on the contrary, the cross flow resistance decreased with the void fraction. The cross flow attack angle against the bundle lattice had little effect on the two-phase cross flow resistance.

705 **(JAERI-M—86-185) Evaluation report on CCTF core-II reflood test C2 - 3 (run 61). Investigation of initial downcomer water accumulation velocity effects.** Okubo, Tsutomu; Iguchi, Tadashi; Akimoto, Hajime; Murao, Yoshio; Sugimoto, Jun; Okabe, Kazuharu. (Japan Atomic Energy Research Inst., Tokyo). Jan 1987. 104p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703612/JAW.

The effects of the downcomer water accumulation velocity in the initial period on the thermo-hydrodynamic behaviors during the reflood phase of a PWR-LOCA was investigated. It is important to investigate this effects in the CCTF in order to confirm that the CCTF test results are applicable to the PWR analyses without any difficulty on the scaling of downcomer flow area. Comparing the data of the present test with those of the base case test, the following results are obtained: The time to fill the downcomer was about 8 s in the present test and was significantly shorter than that in the base case test (i.e. 16 s). The higher downcomer water accumulation velocity in the initial period is considered to result in the observed higher core flooding rate and the larger U-tube type oscillation in the initial period. The intact loop differential pressure, i.e. the steam binding, and the core differential pressure were also observed to increase rapidly. These are considered to reduce the core flooding rate rapidly. By 20 s the core flooding rates for the present test and the base case test were observed to become almost identical. The larger oscillation in the present test was also observed to be damped by 30 s. The core cooling behavior was observed to be almost identical in both tests through the whole transient including the initial period. (J.P.N.).

706 **(KFK—4038) Experiments and correlations of pressure loss coefficients for hexagonal arranged rod bundles (P/D > 1.02) with helical wire spacers in laminar and turbulent flows.** Marten, K.; Yonekawa, S.; Hoffmann, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). May 1987. 63p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753309/JAW.

Advanced pressurized water reactors as well as sodium cooled fast reactors, in their breeding and absorber elements, use tightly packed rod bundles with hexagonally arranged rods. Helical wires or helical fins serve as spacers. The pressure loss coefficients of twelve bundles with helical wires were determined systematically in water experiments. High measuring accuracy was achieved by very precise fabrication of the bundles and the shroud as well as by investigations of the proper measuring techniques. The results show a dependency of the loss coefficients on the Reynolds number and on the P/D and H/D ratios of the bundles. These results together with available systematic experimental results of investigations at P/D > 1.1 were used to develop a correlation to determine the pressure loss coefficients of tightly and widely packed hexagonally arranged rod bundles with helical wire spacers. These correlations were used to recalculate and compare results of pressure loss investigations found in the literature; good agreement was demonstrated. Hence, calculation methods exist for a broad range of applications to determine the pressure loss coefficients of hexagonally arranged rod bundles with helical wires for spacers.

707 **(KFKI—1987-16/G) Monitoring temperature reactivity coefficient by noise method in a NPP at full power.** Aguilar, O.; Por, G. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Apr 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700124/JAW.

A new method based on noise measurement was used to estimate the temperature reactivity coefficient of the PAKS-2 reactor during the entire fuel cycle. Based on the measurements it is possible to measure the dependence of reactivity coefficient on boron concentration. Good agreement was found between the results obtained by the new method and by the conventional ones. Based on this method a new equipment can be develop which assures permanent measurements during operation. 11 refs.; 8 figs.; 3 tables.

708 **(WCAP—11561) Farley Unit 1, EOC-7, 17 x 17 OFA [Optimized Fuel Assembly] onsite examinations report.** Moon, J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Fuel Business Unit). Sep 1987. Contract FC01-85NE34131. 133p. NTIS (US Sales Only), PC A07/MF A01; 1; GPO Dep. Order Number DE88000107/JAW.

This report documents the post-irradiation examinations performed after the fifth fuel irradiation cycle (Reactor Cycle 7) and a performance evaluation of the Optimized Fuel Demonstration Assemblies (OFDA). In addition to the OFDAs, a standard assembly, which had been irradiated for five cycles, and two standard assemblies, which had been irradiated for three cycles, were also examined. The results of the examination are also detailed in this report. A summary of the fuel assembly and fuel rod design is provided in Section 2. The irradiation history of the optimized fuel assemblies is summarized in Section 3. A description of the plant and core characteristics is also provided. Sections 4 through 9 discuss the details of the onsite examinations performed and the results of fuel rod and fuel assembly irradiation performance evaluation. Detailed examination data are included in the appendices.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 820, 821, 822, 842, 846, 857, 858, 859, 860, 882, 1259, 1264, 1743

709 (JAERI-M—86-192, pp 20-28) **Integrity of CAGR moderator bricks.** Prince, N.; Brocklehurst, J.E. (UKAEA Risley Nuclear Power Development Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The procedures for assessing the integrity of moderator bricks in Advanced Gas Cooled Reactors is described together with experiments proposed to improve the graphite input data and verify the condition of bricks at the end of life.

710 (JAERI-M—86-192, pp 43-57) **HTGR fuel element structural design consideration.** Alloway, R.; Gorholt, W.; Ho, F.; Vollman, R.; Yu, H. (GA Technologies, Inc., San Diego, CA, USA). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The structural design of the large HTGR prismatic core fuel elements involve the interaction of four engineering disciplines: nuclear physics, thermo-hydraulics, structural and material science. Fuel element stress analysis techniques and the development of structural criteria are discussed in the context of an overview of the entire design process. The core of the proposed 2240 MW(t) HTGR is described as an example where the design process was used. Probabilistic stress analysis techniques coupled with probabilistic risk analysis (PRA) to develop structural criteria to account for uncertainty are described. The PRA provides a means for ensuring that the proposed structural criteria are consistant with plant investment and safety risk goals. The evaluation of cracked fuel elements removed from the Fort St. Vrain reactor in the U.S.A. is discussed in the context of stress analysis uncertainty and structural criteria development.

711 (JAERI-M—86-192, pp 63-68) **Statistical characterization of tensile strengths for a nuclear-type graphite.** Kennedy, C.R.; Eatherly, W.P. (Oak Ridge National Lab., TN, USA). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

A data set of tensile strengths comprising over 1200 experimental points has been analyzed statistically in conformance with the observed phenomenon of background and disparate flaws. The

data are consistent with a bimodal normal distribution. If corrections are made for strength dependence on density, the background mode is Weibull. It is proposed the disparate mode can be represented by a combination of binomial and order statistics. The resultant bimodal model would show a strong dependence on stress volume.

712 (JAERI-M—86-192, pp 69-74) **Statistical considerations of graphite strength for assessing design allowable stresses.** Ishihara, M.; Mogi, H.; Ioka, I.; Arai, T.; Oku, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

Several aspects of statistics need to be considered to determine design allowable stresses for graphite structures. These include: 1) Statistical variation of graphite material strength. 2) Uncertainty of calculated stress. 3) Reliability (survival probability) required from operational and safety performance of graphite structures. This paper deals with some statistical considerations of structural graphite for assessing design allowable stress. Firstly, probability distribution functions of tensile and compressive strengths are investigated on experimental Very High Temperature candidated graphites. Normal, logarithmic normal and Weibull distribution functions are compared in terms of coefficient of correlation to measured strength data. This leads to the adaptation of normal distribution function. Then, the relation between factor of safety and fracture probability is discussed on the following items: 1) As the graphite strength is more variable than metalic material's strength, the effect of strength variation to the fracture probability is evaluated. 2) Fracture probability depending on survival probability of 99 — 99.9 (%) with confidence level of 90 — 95 (%) is discussed. 3) As the material properties used in the design analysis are usually the mean values of their variation, the additional effect of these variations on the fracture probability is discussed. Finally, the way to assure the minimum ultimate strength with required survival probability with confidence level is discussed in view of statistical treatment of the strength data from varying sample numbers in a material acceptance test.

713 (JAERI-M—86-192, pp 75-89) **Fracture criterion of reactor graphite under multiaxial stresses.** Sato, S.; Kawamata, K.; Kurumada, A.; Awaji, H.; Oku, T. (Ibaraki Univ., Hitachi, Japan. Faculty of Engineering). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

New fracture criteria for graphite under multiaxial stresses are presented for designing core and support materials of a high temperature gas cooled reactor. Different kinds of fracture strength tests are carried out for a near isotropic graphite IG-11. Results show that, under the stress state in which tensile stresses are predominant, the maximum principal stress theory is seen as applicable for brittle fracture. Under the stress state in which compressive stresses are predominant, there may be two fracture modes for brittle fracture, namely, slipping fracture and mode II fracture. For the former fracture mode the maximum shear stress criterion is suitable, but for the latter fracture mode the following mode II fracture criterion including a restraint effect for cracks is verified to be applicable, σ/sub 3/ = {σ/sub c//σ/sub t/(K/sub Ic//K/sub IIc/) - 1}σ/sub 1/ - σ/sub c/ where σ/sub 1/ and σ/sub 3/ are the maximum and minimum principal stresses, σ/sub t/ and σ/sub c/ are the tensile and compressive strengths and K/sub Ic/ and K/sub IIc/ are the mode I and II fracture toughness values, respectively. The above equation is similar in form to the Coulomb-Mohr criterion. Also a statistical correction for brittle fracture criteria under multiaxial stresses is discussed. By considering the allowable stress values for a safe design, the specified minimum ultimate strengths corresponding to a survival probability of 99 % at the 95 % confidence level are presented.

714 (JAERI-M—86-192, pp 133-137) **High temperature Young's modulus of IG-110 graphite.** Konishi, T.; Eto, M.; Oku, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

Data on Young's modulus of nuclear graphite at high temperature are required for the design and safety analysis of the VHTR. The purpose of the present experiment is to obtain Young's modulus data for the graphite materials used in the VHTR. An ultrasonic wave pulse method was applied up to a temperature of 1400 deg C. The Young's modulus of oxidized materials was also measured. The results were compared with tensile strength at high temperature to estimate the tensile strength non-destructively. Tensile tests were carried out at 600 deg C and 1000 deg C in a vacuum chamber. Specimens were oxidized to three weight loss levels (3.5 %, 5.0 %, 7.0 %) in air at 550 deg C. Young's modulus increased with increasing temperature. Temperature dependence of Young's modulus became less pronounced as the amount of oxidation increased. In the specimens oxidized to more than 5 %, the Young's modulus first decreased slightly with increasing temperature and the temperature at which the Young's modulus started to rise sifted to higher region with increasing weight loss. Young's modulus and tensile strength at high temperature up to 1000 deg C were correlated with each other using an equation: (σ/σ/sub 0/) = (E/E/sub 0/)/sup 1/2/, where σ, σ/sub 0/, E and E/sub 0/ denote tensile strength at given temperature, tensile strength at room temperature, Young's modulus at given temperature, Young's modulus at room temperature, respectively.

715 (JAERI-M—86-192, pp 169-175) **Nondestructive testings of HTGR graphites.** Maruyama, T.; Uragaki, H.; Fujii, M.; Ooka, K.; Sakashita, T.; Suzuki, H.; Oku, T. (Tokyo Inst. of Tech., Japan. Research Lab. of Nuclear Reactor). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

This paper describes the results of nondestructive testing of fine-grained, high density, isotropic graphites which are candidate materials to be used in the reactor core of an HTGR. Specimens which containes flaws with various shape and size were fabricated and tested using a pulsed ultrasonic method and an X-ray computed tomography technique. The ultrasonic testing was done using high resolution transducers of longitudinal wave at frequencies 1 and 2.25 MHz. The relationship between ultrasonic echo amplitude and dimension of flaws was obtained. The results was compared with calculated values. The X-ray computed tomography test was done using a commercially available apparatus. Flaws in the graphites were clearly shown and investigation was made to obtain limit of detection of both lamellar and bulk flaws in the nuclear graphites.

716 (JAERI-M—86-192, pp 182-188) **Graphite corrosion under severe HTR accident conditions.** Katscher, W.; Moormann, R. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

In connection with analyses of severe, mainly hypothetical air and water ingress accidents in High Temperature Gas-Cooled Reactors (HTR), the paper deals with the kinetics of the reactions between matrix respectively structural graphite materials for the German HTR projects and oxygen, carbon dioxide and water vapour. With helium as carrier gas, the experiments presented were carried out in the in-pore diffusion controlled regime taking into consideration the burn-off dependence of the reaction rate: the results are given for maximum rates valid for that graphite burn-off field in which the reaction rate no longer increases with burn-off. In the case of the water gas reaction, reaction rates are given as a function of preasure up to 55 bar. As an example for the accident

analyses mentioned above the benign behaviour of a pebble bed reactor core with respect to temperature development, migration of reaction zones, burn-off distribution etc. is demonstrated for hypothetical air ingress into the primary circuit of a medium size HTR.

717 (JAERI-M—86-192, pp 189-194) **Estimation of graphite materials corrosion with water-vapor in coolant of the VHTR and oxidation effect on the materials properties.** Eto, M.; Kurosawa, T.; Imai, H.; Nomura, S.; Oku, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

Corrosion experiments have been carried out mainly on a fine-grained isotropic graphite, IG-110, at temperatures 1173 and 1473 K in a water vapor/helium mixture. Water vapor concentration was 0.65 vol% and helium pressure, 1 atm. Reaction rate and burn-off profile were measured using cylindrical specimens. On the basis of the experimental data the corrosion behavior of fuel block and core support post under the condition of the VHTR operation was estimated using the first-order or Langmuir-Hinshelwood equation with regard to water vapor concentration. Strength and stress-strain characteristics of the components with burn-off profiles estimated above were analyzed on the basis of the model for stress-strain relationship and strength of the graphite with oxidation gradients. The estimation indicated that the integrity of the components would be maintained during their service lives.

718 (JAERI-M—86-192, pp 195-200) **Graphite corrosion rate equation under high concentration water-vapor in helium and an estimation of the VHTR support post corrosion and strength.** Nomura, S.; Kurosawa, T.; Imai, H.; Eto, M.; Oku, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

To estimate corrosion of a candidate graphite material IG-110 in the very high temperature gas-cooled reactor, a rate equation for oxidation with water-vapor in-pore diffusion control regime was derived applying Langmuir-Hinshelwood mechanism as contribution of chemical rate for the over all oxidation rate. On the basis of the equation, the corrosion behaviors of the core support post graphite material were studied by using various dependence of the chemical rate on water-vapor concentration and by using laboratory data obtained in the oxidation of IG-110 graphite specimen with water-vapor of 6.5 x 10/sup -3/ atm in helium stream at atmospheric pressure. The corrosion rate, weight loss with time was calculated for core support post graphite under water ingress accident of the reactor. Results calculated based on the equation were compared with those calculated by another equation, in which the chemical rate is assumed to be directly proportional to the concentration of water-vapor. It was found that the former gives the weight loss approximately one order of magnitude smaller than the latter in the case of water ingress accident. The results obtained by the equation using Langmuir-Hinshelwood mechanism are considered to be more reliable. The time needed to reach steady state concentration profile of water vapor in the core support post graphite was also evaluated. Local burn-off profiles across the post were figured based on the steady state concentration profile of water-vapor in it. The changes in compressive strength brought by the corrosion in accident were also estimated.

719 (JAERI-M—86-192, pp 207-212) **Matrix graphite for HTGR spherical fuel elements some their properties.** Chernikov, A.S.; Mozzherin, S.I.; Reshetnikov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The results of investigations on matrix graphites for HTGR spherical fuel elements are presented, with two types of artificial carbon materials (coarse-grain anisotropic graphite 30PG and fine-grain isotropic MPG-6) and coal-tar pitch taken as an example. The data are given on physical-mechanical and thermal-physical characteristics and on the rate of corrosion of matrix materials in the stage of both pre- and post-irradiation (for the material based on graphite 30PG) investigations. The variations in the anisotropy of the main properties of matrix graphites have been determined depending on type of graphite filler. It is concluded that the matrix graphite characteristics attained mainly agree with the requirements for the fuel elements of the VGR-50 and VG-400 reactors under development.

720 (JAERI-M—86-192, pp 217-221) **Elastic-plastic fracture toughness of HTGR graphites.** Oku, T.; Ishiyama, S.; Eto, M.; Inagaki, M.; Hashida, T.; Takahashi, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

A fracture mechanics approach is important for evaluating the possibility of extension of cracks in graphite components in an HTGR. The effects of various factors on J-integral values which correspond to the initiation of crack extension were examined for the purpose of establishing a test method for obtaining the valid toughness value. Materials tested are five grades of HTGR candidate graphites. The compact tension specimen was used for evaluating elastic-plastic fracture toughness values. As the size of the notch root radius of CT specimens increases, J-integral values increase. J/sub in/ values which corresponds to the crack initiation point are nearly constant when the notch root radius is below 0.2 mm. J/sub in/ values are not affected by the crosshead speed between 0.005 mm/min and 0.05 mm/min and by a ratio of crack length to width between 0.4 and 0.55. J/sub in/ values depend on the thickness of specimen and become constant above a value of thickness which depends on the graphite grade. From these results the conditions for obtaining valid fracture toughness values were made clear. J/sub in/ values and J-R curves showed anisotropy which is reflected by the preferred orientation of the basal plane in the graphite blocks. Frequency spectra of acoustic emission associated with crack extension could be classified into some types which depend on the graphite grade.

721 (JAERI-M—86-192, pp 222-226) **Fatigue behavior of fine-grained isotropic graphite for HTGRs.** Ishiyama, S.; Eto, M.; Oku, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The principal purpose of this study is to examine the effect of stress ratio, volume, temperature, irradiation and oxidationon fatigue strength of nuclear graphite. Results were summarized as follows; 1) The fatigue tests were performed at stress ratio of 0.5, 0.0, -1.0, -3.5, $+\infty$, 1/0.3 and 1/0.7 at room temperature and in air. Fatigue data were analyzed statistically and summarized in a modified Googman fatigue diagram. 2) Fatigue tests were performed with many different sizes of specimens and no pronounced difference of fatigue strength was found. 3) The tests were performed at 980 deg C in a vacuum. It was shown that fatigue strength increased about 1.05 times of that at room temperature. 4) Irradiations were performed at temperatures of 575 — 650 deg C to a influence of 1.92 x 10/sup 20/ — 3.20 x 10/sup 20/ n/cm/sup 2/. It was shown that the fatigue strength increased to the value 1.2 times of the unirradiation. 5) Oxidation was performed at 500 deg C in air. It was shown that fatigue strength after oxidation decreased as oxidation proceeded.

722 (JAERI-M—86-192, pp 233-238) **Experience obtained from construction and preliminary test of in-core structure test section (T-2).** Kunitomi, K.; Inagaki, Y.; Ioka, I.; Kondo, Y.; Miyamoto, Y.; Shimomura, H.; Akisada, T.; Yamaguchi, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The in-core structure test section (T/sub 2/) in Helium Engineering Demonstration Loop (HENDEL) simulates a part of the core bottom structure with the same scale as that of a very high temperature reactor (VHTR) in JAERI. The main objectives of T/sub 2/ are to verify the following items by testing under the same condition as that of the VHTR : (1) sealing performance through the side gaps between permanent reflector blocks, and inspection of an accuracy in fabrication, (2) insulation performance of the carbon blocks, (3) mixing characteristic of the hot plenum, (4) structural integrity of the core bottom structure. The design and construction of T/sub 2/ were started in March 1983, and a preliminary test was carried out in June 1986. In the construction of T/sub 2/, a fabricating technology of the graphite blocks and electric graphite pipe heater for raising up the temperature of the helium gas was developed as well as that of another metal structure. Especially, the technology of the graphite blocks is thought to be prime importance to achieve the outlet coolant temperature of 950 deg C. If the side gap between the reflector blocks around the core were wider than 0.2 mm, the outlet temperature would become lower than 950 deg C because of leaking cold coolant gas. The preliminary test revealed that the flow rate of leakage was about 30 % of the expected value, because the gap was about 1/5 of the design value of 0.2 mm. These data would be useful for licensing and design work of the VHTR.

723 (JAERI-M—86-192, pp 37-42) **Mechanical design philosophy for the graphite components of the core structure of an HTGR.** Bodmann, E. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim, Germany, F.R.). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

Parallel to the layout and design of the graphite components for THTRs and the succeeding high temperature reactor projects, the design methods for graphite components have been improved over the years. The aim of this works is to develop the design methods which take into account both the particular properties of graphite and the particular functions of the components. Because of the close relation ship between materials and design codes, this development work has progressed with the development, testing and qualification of German reactor graphite. In this paper, the experience in this field of Hochtemperatur Reaktorbau GmbH and the results of the work and approach to the design problems are reported. The example of a HTR 500 design for a 550 MWe power station is taken up, and the core structure is explained. The graphite components are divided into three classes according to the stress limits. The loading of these components is reviewed. The aim of the design is not the complete avoidance of failure, but to avoid the failure of a single component from leading to a disadvantageous consequence which is not allowable. The classification of loading events, Weibull statistics and maximum allowable stress, the formation of the permissible stress, the assessment of stress due to multiaxial loading and so on are described. (Kako, I.).

724 (JAERI-M—86-192, pp 58-62) **Structural design of reactor core and support graphite components for the experimental VHTR.** Arai, T.; Mogi, H.; Iyoku, T.; Ide, A.; Takikawa, N. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The HTGR development in Japan has been pursued long since, aiming at the multipurpose use of nuclear energy, particularly the application of nuclear heat to process industries. Japan Atomic Energy Research Institute has achieved remarkable progress in the design and basic technology of HTGRs in cooperation with Japanese industries and institutions as well as the international collaboration. For the past several years, the development activities have been concentrated in establishing the technical base for constructing an experimental very high temperature reactor (VHTR). The experimental VHTR is a helium-cooled, graphite-moderated reactor producing 50 MWt with the core outlet gas temperature of 950 deg C. In the course of the recent design development, a 30 MWt reactor design has been worked out aiming at the rationalization. This paper presents the structural design features of the graphite components for the experimental VHTR. Special reference is made to the structural function, design stress limit, and design method of the graphite components. The in-vessel arrangement of graphite components is shown. The core consists of an array of prismatic graphite components, and is surrounded by large sized permanent support components. Special consideration is given to decrease coolant bypass and to increase resistance to a seismic load. (Kako, I.).

725 (JAERI-M—86-192, pp 90-98) **Structural assessment of prismatic blocks for pin-in-block fuel element.** Takikawa, N.; Koike, H.; Tanaka, M.; Arai, T.; Iyoku, T.; Ide, A. (Kawasaki Heavy Industries Ltd., Tokyo, Japan). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The reference design of the standard fuel elements for the experimental very high temperature gas-cooled reactor (VHTR) is based on the prismatic pin-in-block type fuel elements using IG-11 graphite material. The variants of VHTR standard PIB fuel elements have been designed mainly from a viewpoint of improving the thermal performance of the VHTR core. The dimensions of these variants are shown. Based on the above variants, the structural assessment was carried out by using the computer programs for two- and three-dimensional finite element methods, and also taking the effect of fast neutron irradiation into account. In this paper, the operating stress, residual shutdown stress and seismic stress at the block joints of a standard PIB type fuel element are reported. Finally, the conclusion of the assessment to be recommended on the current VHTR PIB type fuel elements is discussed. Thermal and irradiation-induced stresses, seismic stress, stress evaluation method, analytical approach to accurately determine the temperature field and stress in specified fuel elements and so on are described. The parameters controlling the thermal stress field are the temperature difference of coolant and the thickness of outer webs. Regarding the irradiation-induced stress, the average temperature of graphite has a significant effect on the irradiation load and dose. Dowel socket joints are preferable in view of seismic load. (Kako, I.).

726 (JAERI-M—86-192, pp 99-107) **Experimental and theoretical evaluation of core alignment structures against a seismic load.** Ide, A.; Miki, T.; Matsumura, M.; Mogi, H.; Ishihara, M.; Koike, H. (Fuji Electric Co. Ltd., Tokyo, Japan). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The core of the multi-purpose experimental very high temperature reactor (E-VHTR) consists of the columns arranged so as to form a honeycomb structure, and each column is composed of stacked up hexagonal graphite blocks. Since the channels for coolant or control rods are provided for the graphite blocks, an upper and a lower blocks must be so positioned that the channels are aligned. For this alignment, dowel and socket joints are used. Also flange type aligning devices were developed recently particularly for limiting coolant leak. When a seismic load acts on the core, each column oscillates as a beam, colliding with adjacent columns. Therefore, the dowel or the flange area and the sides of each block are subjected to a large shearing stress and a compressive stress, respectively. The shearing stress is important in view of the material

properties of graphite. Three types of the graphite fuel blocks designed for the E-VHTR were put to the breaking test by the static loading simulating seismic load. In this paper, the results of the verification of the block strength by the test and analysis are reported. The design requirement for the core components, the strength of dowel type and flange type fuel elements and so on are described. The dowel and socket strength satisfied that required by the design. (Kako, I.).

727 (JAERI-M—86-192, pp 108-112) **Structural strength of core graphite bars.** Kikuchi, K.; Futakawa, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

A HTR core consists of fuel, hot plenum, reflector and thermal barrier blocks. Each graphite block is supported by three thin cylindrical graphite bars called support post. Static and dynamic core loads are transmitted by the support posts to the thermal barrier blocks and a support plate. These posts are in contact with the blocks through hemispherical post seats to absorb the relative displacement caused by seismic force and the difference of thermal expansion of materials at the time of the start-up and shutdown of a reactor. The mixed fracture criterion of principal stress and modified Mohr-Coulomb's theory as well as the fracture criterion of principal stress based on elastic stress analysis was discussed in connection with the application to HTR graphite components. The buckling fracture of a support post was taken in consideration as one of the fracture modes. The effect that the length/diameter ratio of a post, small rotation and the curvature of post ends and seats exerted on the fracture strength was studied by using IG-110 graphite. Contacting stress analysis was carried out by using the structural analysis code 'COSMOS-7'. The experimental method, the analysis of buckling strength and the results are reported. The fracture of a support post is caused by the mixed mode of bending deformation, split fracture and shearing fracture. (Kako, I.).

728 (JAERI-M—86-192, pp 128-132) **Development and testing of nuclear graphite for the German pebble-bed high temperature reactor.** Haag, G.; Delle, W.; Nickel, H.; Theymann, W.; Wilhelmi, G. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

Several types of high temperature reactors have been developed in the Federal Republic of Germany. They are all based on spherical fuel elements being surrounded by graphite as reflector material. As an example, HTR-500 developed by the Hochtemperatur Reaktorbau GmbH is shown. The core consists of the top reflector, the side reflector with inner and outer parts, the bottom reflector and the core support columns. The most serious problem with respect to fast neutron radiation damage had to be solved for the materials of those parts near the pebble bed. Regarding the temperature profile in the core, the top reflector is at 300 deg C, and as cooling gas flows from the top downward, the temperature of the inner side reflector rises to about 700 deg C at the bottom. Fortunately, the highest fast neutron load accumulated during the life time of a reactor corresponds to the lowest temperature. This makes graphite components easier to survive neutron exposure without being mechanically damaged, although the maximum fast neutron fluence is as high as 4 x 10/sup 22//cm/sup 2/ at about 400 deg C. HTR graphite components are divided into four classes according to loading. The raw materials for nuclear graphite, the development of pitch coke nuclear graphite, the irradiation behavior of ATR-2E and ASR-IRS and others are reported. (Kako, I.).

729 (JAERI-M—86-192, pp 163-168) **Notch sensitivity of graphite materials for VHTR.** Kawakami, Haruo. (Fuji Electric Corp. Research and Development Ltd., Yokosuka, Kanagawa, Japan). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

Most components in the core of a HTGR are made of graphite materials. These materials are efficient neutron moderators, and have high strength at high temperature, accordingly these have been used as nuclear materials long since. But the fracture mechanism of these materials is very peculiar, and has not been fully understood. Notch sensitivity is one of the most important properties in the design of the core structure. The experimental data on IG-11 and PGX have been scarcely reported, though these are the promising materials for the experimental VHTR is Japan. The authors investigated into the notch sensitivity of these materials by uniaxial tensile test, compressive test and thermal shock test by water quenching. The test materials were IG-11, SP2020 and PGX. The experimental method and the results are reported. The notch sensitivity of graphite materials in uniaxial tensile test became smaller as notch radius became smaller. The notch sensitivity of IG-11 was larger than that of PGX. The compressive fracture of PGX was of shear mode, while that of IG-11 was of the mixed mode of shear and transverse split. The thermal shock fracture resistance (TSFR) parameter of IG-11 was larger than that of PGX. But when a notch of a small radius existed, the TSFR of IG-11 was sometimes smaller than that of PGX. (Kako, I.).

730 (JAERI-M—86-192, pp 176-181) **Achieving optimum graphite performance in AGR core and fuel.** Norfolk, D.J.; Johnston, G.O.; Tucker, M.O. (Central Electricity Generating Board, Berkeley, UK. Berkeley Nuclear Labs.). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The Central Electricity Generating Board has a total of five twin-reactor nuclear power stations on four sites using advanced gas-cooled reactors (AGR), of which the earliest was commissioned in 1976, and the last is expected to begin the commercial operation in the next year. All have graphite cores, and are cooled by CO/sub 2/. So far, the core has not been replaced. If the performance of graphite deteriorates too rapidly, the life of reactors ends prematurely. In AGRs, a complex coolant flow path allows high power density and thermal efficiency, hence particularly favorable economical performance, combined with acceptably low core graphite temperature. The gas flow in a channel is separated with annular graphite sleeves, which also support a fuel pin, and are replaced with fuel every 5 - 7 years. This work falls n three main areas. The first is to develop the method of assessing and predicting the performance throughout component life. The second is to optimize operating conditions, particularly coolant composition, so as to delay deterioration. The third is to develop surveillance and monitoring method. This paper summarized the process affecting core and fuel graphite performance in the AGR environment, and describes progress in several key areas. Effect of radiation on graphite, consequence for moderator performance, development of AGR coolant composition, stress prediction and so on are reported. (Kako, I.).

731 (JAERI-M—86-192, pp 201-206) **Radiation effect on the graphite of HTGR.** Platonov, P.A.; Strombach, Ya.I.; Karpukhin, V.I.; Gurovich, B.A.; Chugunov, O.K.; Trofimchuk, E.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

For predicting the operability of graphite structures for modern nuclear installations, it is necessary to know the rules of radiation-induced changes in such properties of graphite as stability of dimensions, strength, creep, modulus of elasticity, coefficient of thermal expansion, heat conductivity and resistance to oxidation in a wide temperature range and at fast neutron fluence more than 10/sup 22//cm/sup 2/. The dimensional change of graphite under irradiation is the most important parameter which determines the operability of HTGR graphite structures. The effect of irradiation on the thermophysical and mechanical properties of graphite is report-

ed. The change of microstructure of graphite was also studied. One of the effective methods enabling to avoid cracking in nuclear graphite under irradiation is the production of the nuclear graphite with the difference of crystal grain size as small as possible. At low irradiation temperature, the change of crystal grain size occurs to a certain limit due to the change of the crystal lattice caused by radiation defects. At high irradiation temperature, the lattice parameters change less, and above 500 deg C, the change is negligible. Nuclear polycrystalline graphite changes complicatedly its dimensions due to porosity. One of the most important properties of stressed and strained graphite is the radiation creep. (Kako, I.).

732 **(JAERI-M—86-192, pp 239-242) Results of the visual in-pile inspection of the inner graphite reflector of the AVR.** Haag, G.; Delle, W.; Kirch, N.; Nickel, H.; Reinhart, K.; Ziermann, E. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The nuclear power reactor AVR constructed by Arbeitsgemeinschaft Versuchs-Reaktor GmbH is an independent part of the Julich Nuclear Research Center. In 1960s, the AVR was built to demonstrate the feasibility and the reliability of a high temperature reactor using spherical fuel elements. The electrical power output is 15 MW, and the thermal output is 46 MW, which is produced by 92,000 fuel elements of 60 mm diameter, and helium is used as the cooling gas. The power generation began in December, 1967, and since then, about 1.5 billion kWh has been generated. One of the most important events during the operation of nearly 20 years was the raise of the exit temperature of cooling gas from 850 deg C to 950 deg C in February, 1974. Kernforschungsanlage Julich planned to modify the high temperature reactor AVR so as to be usable as a process heat source. The theoretical consideration based on the irradiation behavior of actual nuclear graphite cannot completely avoid the damage caused by irradiation-induced stress. Therefore, visual inspection was performed for the top and side reflectors in May, 1984. The construction of the core, the irradiation test of ARS/AMT graphite, the estimation of stress in the reflector components, the visual inspection and the cameras used and so on are reported. As the result, cracking and corrosion were not found at all. (Kako, I.).

733 **(JAERI-M—87-056) Evaluation of the oxidation behavior and strength of the graphite components in the VHTR. (1). Normal operation condition.** Eto, Motokuni; Kurosawa, Takeshi; Nomura, Shinzo; Imai, Hisashi. (Japan Atomic Energy Research Inst., Tokyo). Apr 1987. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750044/JAW.

Oxidation experiments have been carried out mainly on a fine-grained isotropic graphite, IG-110, at temperatures between 1173 and 1473 K in a water vapor/helium mixture. In most cases water vapor concentration was 0.65 vol% and helium preasure, 1 atm. Reaction rate and burn-off profile were measured using cylindrical specimens. On the basis of the experimental data the oxidation behavior of fuel block and core support post under the condition of the VHTR operation was estimated using the first-order or Langmuir-Hinshelwood equation with regard to water vapor concentration. Strength and stress-strain relationship of the graphite components with burn-off profiles estimated above were analyzed on the basis of the model for stress-strain relationship and strength of graphite specimens with density gradients. The estimation indicated that the integrity of the components would be maintained during normal reactor operation.

734 **(JAERI-M—87-058) Operation, maintenance and inspection of HENDEL from March 1986 to February 1987.** Shimomura, Hiroaki; Okuyama, Kunito; Kondo, Yasuo. (Japan Atomic Energy Research Inst., Tokyo). Apr 1987. 52p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750287/JAW.

The technical features are summarized with important test results and disturbances through the operation of HENDEL in the period from March 1986 to February 1987. In the period, HENDEL M + A loop was operated comparatively stable with T/sub 1/ and newly adapted T/sub 2/. As to the adaptation of T/sub 2/, the hot gas duct was dismantled and examined for old one and new ducts were constructed between M + A loop and T/sub 2/. Besides the operation and adaptation, the adjustments and maintenance had been carried out for the regular inspection and safety operations. The technical disturbances were encountered with the gas circulators and the electric power system through the operation. From the countermeasures and the tests for them, some technical informations have obtained and are expected to give valuable data for design and operation of the VHTR and general industrial system.

735 **(JAERI-M—87-060) Analysis code of three dimensional core dynamics for high temperature gas-cooled reactors, COMIC-2.** Takano, Makoto. (Japan Atomic Energy Research Inst., Tokyo). Apr 1987. 53p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750043/JAW.

The code has been improved and modified in order to speed-up calculation and to make more effective since it was developed in 1985. This report is written as a user's manual of the latest version of the code (COMIC-2). Speedup of the code is performed by the improvement of program flow and vector programming. The total speedup factor depends on problem, however, is about 10 in the case of a sample ploblem.

736 **(JAERI-M—87-071) Thermal efficiency of the GT-HTGR combined cycle power generation plant.** Yamada, Seiya; Miyamoto, Yoshiaki; Muto, Yasushi. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 111p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750288/JAW.

The GT-HTGR plant combines the High Temperature Gas Cooled Reactor (HTGR) core with the closed-cycle helium gas turbine power conversion system, which uses the reactor coolant directly as the working fluids, and can achieve higher thermal efficiency with simple configuration. This paper presents characteristics of the binary power generation plant which combined the GT-HTGR plant with the steam Rankin cycle plant and calculating results for the thermal efficiency of the binary plant. The results make it clear influence of the topping cycle and bottoming cycle on the total thermal efficiency.

737 **(JAERI-M—87-082) Forced-vibrational test for the support post structure of HTTR.** Futakawa, Masatoshi; Kikuchi, Kenji; Muto, Yasushi; Tachibana, Katumi. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 23p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750301/JAW.

In order to evaluate the vibrational characteristics of the support post structure which constitutes a bottom-core structure in HTTR, a forced-vibrational test has carried out by using a two-dimensional model for the support post structure. The experimental results have been compared with the analytical ones obtained from the Lagrange's equation. The following are the conclusions derived: (1) The restoring force characteristics of the support post structure are able to be described by two spring constants, in which positive and negative constants represent rolling and sliding motions, respectively. (2) The forced-vibrational behavior which includes both the rolling and sliding motions can be predicted by using the analytical result obtained from the Lagrange's equation.

738 **(JAERI-M—87-085) TRANCS, a computer code for calculating fission product release from high temperature gas-cooled reactor fuel. (1). Diffusion and recoil release from a bare kernel and coated fuel particles.** Hayashi, Kimio; Fukuda, Kousaku. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 55p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750293/JAW.

The computer program, TRANCS, has been developed for evaluating the fractional release of long-lived fission products from coated fuel particles. This code numerically gives the non-stationary solution of the diffusion equation with birth and decay terms.

The birth term deals with the fissile material in the fuel kernel, the contamination in the coating layers and the fission-recoil transfer from the kernel into the buffer layer; and the decay term deals with effective decay not only due to beta decay but also due to neutron capture, if appropriate input data are given. The code calculates the concentration profile, the release to birth rates (R/B), and the release and residual fractions in the coated fuel particle. Results obtained numerically have been in good agreement with the corresponding analytical solutions after the Booth model. Thus, the validity of the present code was confirmed, and further undate of the code has been discussed for extention of its computation scopes and models.

739 **(Juel—2113) Research technique improvement and construction of the charging facility of the high temperature reactor.** Thomas, H.R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Jan 1987. 117p. (In German). NTIS, PC E11; NTIS as TIB/B87-11594.

The method presented in this work to discharge spherical balls out of the high temperature reactors works mere pneumatically. The modern discharge installation is very easy constructed and possesses no movable parts. The fundamental experiments to investigate the influence of geometry parameters are described. The experiments, which allow statements to the behaviour of spheres under different operation conditions are explained. Furtheron the test facility is described in the scale size 1:2, in which the operation of the discharge was demonstrated. Beside this it was possible to prove that as well spheres as appearing sphere fracture could be discharged out of the reactor. The final concept proposal shows the possibility for the fitting of a pneumatically operating discharge in a HTR. The type is introduced on the basis of the HTR-100-industrial nuclear power plant of the company Hochtemperatur-Reaktorbau GmbH, Mannheim.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 844

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 706, 824, 839, 865, 866, 896, 911, 917, 919, 920, 921, 922, 1187, 1342, 2705

740 **(CEA-CONF—8888) About the vibratory instability of the Superphenix reactor weir.** Attia, S.; Gibert, R.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Nov 1986. 14p. (In French). (CONF-8611182—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752927/JAW.

From G.K.A.E.E. seminar; Cadarache, France (24 Nov 1986).

A vibratory instability was discovered during the hot tests of Superphenix. This instability is due to the fluid discharge over a flexible weir which separates two thin fluid sheets (the feeding and restitution collectors). A large investigation program was undertaken, including field tests and tests on mockups, as also the development of a theoretical model. The whole program led to an efficient solution concerning Superphenix vibrations, simple solution, and without consequence on the development of the project. 7 references.

741 **(FRNC-TH—2932) Homogenization of the coefficient of diffusion: influence of modelling and of the laplacian for fast power reactors and experimental mockups.** Gho, C.J. (Grenoble-1 Univ., 38 (France)). Oct 1984. 184p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87752742/JAW.

Neutron transport calculation of reactors is based on the definition of homogeneized cell constants, the diffusion coefficient among others. The formalism of the evaluation of the diffusion coefficient, as also the cell model used may introduced uncertainties in results. The present study allowed to estimate these uncertainties in the case of fast neutron power reactors and criticical mockups. The validation of new simple methods and the definition of references is a consequence of this work.

742 **(INIS-BR—786) Necessity of electricity and the unavoidable use of nuclear energy.** (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). [1987]. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703531/JAW.

The development of fast breeder type reactors is presented as the best and practically the unique energetic solution for Brazilian future. The program of development proposed by IEAv (Intitute of Advanced Studies) researchers aim to supply enough and constant electricity, transforming the Brazilian energy power, practically infinite by using nuclear reactors inherently more safe than other existing in developed countries. (M.C.K.).

743 **SAFR - A utility option for the 21st century.** Guenther, E.; Brunings, J.E.; Golan, S. (Combustion Engineering, Inc., Windsor, CT). pp 64-67 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—).

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

Rockwell International, with support from major subcontractors Combustion Engineering and Bechtel National, is developing the Sodium Advanced Fast Reactor (SAFR) as one element in the United States Department of Energy's Advanced Liquid Metal Reactor (LMR) Program. The SAFR plant concept employs a 350-MWe pool-type liquid metal reactor Power Pak as its basic module. The Power Pak is a standardized unit, for which the reactor assembly is largely shop-fabricated and can be shipped to the plant site be barge for installation. Shop fabrication minimizes nuclear-grade (ASME Section III) field fabrication and reduces plant construction schedule. Power Pak modules can be used individually or in multiples at a given site to supply the needed electrical capacity.

744 **Heat transfer augmentation in liquid metal reactor steam generators.** Carlson, R.D.; France, D.M.; Gabler, M.J.; Kim, K.; Veljovich, W. (Argonne National Lab., Argonne, IL). pp 211-218 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—). Contract W-31-109-ENG-38;AC03-83SF11901.

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The use of heat transfer augmentation devices has been proposed as a means for reducing the cost of steam generators for advanced LMR designs by approximately 25%. Experimental results are presented for two types of enhancers in the form of a twisted-tape and a core-tube insert in the steam tube of a 13.1-m-long, sodium-heated single-tube test section. Test parameters were prototypical of liquid metal reactor (LMR) steam generator design for a once-through high-pressure steam cycle. Heat transfer results are compared with the no-insert case on an overall and local basis. Although both augmentations increased overall performance, the mechanisms were different.

745 **Extended overpower transient testing of LMFBR oxide pins in EBR-II.** Tsai, H.; Neimark, L.A.; Tani, S.; Shibahara, I. (Argonne National Lab., IL). pp 287-293 of Nuclear fuel performance. London, England; BNES (1985).

As part of a joint effort between the Power Reactor and Nuclear Fuel Development Corp. of Japan and the US Dept. of Energy, a series of five extended slow overpower transient tests are being conducted in the Experimental Breeder Reactor-II (EBR-II) on preirradiated mixed oxide fuel and blanket pins. In the first two tests conducted in the series, fuel and blanket pins were subjected to a 0.1%/s power ramp to ~ 60% overpower before the transient termination. None of the test pins breached during the transient. A

significant cladding breaching margin over the normal PPS trip setting of ~ 12-15% was thus demonstrated for the 0.1%/s ramp. The transient-induced spin cladding strains, caused principally by fuel-cladding mechanical interaction, were small but measurable. 5 references, 7 figures, 2 tables.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 765

746 **(N—87-25838) Nuclear reactor power for a space-based radar. SP-100 project.** Bloomfield, H.; Heller, J.; Jaffe, L.; Beatty, R.; Bhandari, P.; Chow, E.; Deininger, W.; Ewell, R.; Fujita, T.; Grossman, M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1986. 176p. (NASA-TM—89295; JPL-PUB—86-47; NAS—1.15:89295). NTIS, PC A09/MF A01.

A space-based radar mission and spacecraft, using a 300 kWe nuclear reactor power system, has been examined, with emphasis on aspects affecting the power system. The radar antenna is a horizontal planar array, 32 X 64 m. The orbit is at 61 deg, 1088 km. The mass of the antenna with support structure is 42,000 kg; of the nuclear reactor power system, 8,300 kg; of the whole spacecraft about 51,000 kg, necessitating multiple launches and orbital assembly. The assembly orbit is at 57 deg, 400 km, high enough to provide the orbital lifetime needed for orbital assembly. The selected scenario uses six Shuttle launches to bring the spacecraft and a Centaur G upper-stage vehicle to assembly orbit. After assembly, the Centaur places the spacecraft in operational orbit, where it is deployed on radio command, the power system started, and the spacecraft becomes operational. Electric propulsion is an alternative and allows deployment in assembly orbit, but introduces a question of nuclear safety.

747 **(PNL-SA—15084) Low gravity fluid-thermal experiments.** Krotiuk, W.J.; Cuta, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 18p. (CONF-8706214—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000553/JAW.

From 3. pathways to space experimentation workshop; Orlando, FL, USA (3 Jun 1987).

Pacific Northwest Laboratory (PNL) is the lead laboratory for the thermal-hydraulic research in the US Department of Energy Multimegawatt Space Nuclear Power Program. PNL must provide the tools necessary to analyze proposed space reactor concepts, which include single- and two-phase alkali metal and gas-cooled designs. PNL has divided its activities for this task into three basic areas: computer code development, thermal-hydraulic modeling, and experimentation. The subject of this paper is the low-gravity experimental program currently underway at PNL in support of the MMW Program.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 734, 770, 885, 896, 897, 914, 916, 925

748 **(NUREG—0540-Vol.9-No.7) Title list of documents made publicly available, July 1-31, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Sep 1987. 565p. NTIS, PC A24 - GPO. Order Number TI88900098/JAW.

This document is a monthly publication containing descriptions of information received and generated by the US NRC. This information includes: (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials; and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author Index, Corporate Author Index, Report Number Index, and Cross Reference to Principal Documents Index.

749 **(NUREG—0540-Vol.9-No.8) Title list of documents made publicly available, August 1-31, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Oct 1987. 403p. NTIS, PC A18 - GPO. Order Number TI88900143/JAW.

This monthly publication contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979. Microfiche of the docketed information listed in the Title List is available for sale on a subscription basis from the National Technical Information Service (NTIS).

750 **(NUREG—1214-Rev.2) Historical data summary of the Systematic Assessment of Licensee Performance.** Ramey-Smith, A.M. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Licensee Performance and Quality Evaluation). Oct 1987. 69p. NTIS, PC A04/MF A01 - GPO. Order Number DE88900101/JAW.

The Historical Data Summary of the Systematic Assessment of Licensee Performance (SALP) is produced periodically by the US Nuclear Regulatory Commission. This summary provides the results of the assessment for each facility by NRC region and is further divided into the following three sections: the most recent SALP report ratings for facilities under construction and in operation, a chronological listing of all SALP report ratings for each operating facility, a chronological listing of all SALP report ratings for each facility under construction. For historical purposes, past construction SALP ratings for facilities that recently have been licensed also are listed.

2108 Economics

REFER ALSO TO CITATION(S) 696, 845, 913, 915, 916

22 NUCLEAR REACTOR TECHNOLOGY

751 **(INIS-mf—10907) AUTOS '85. Part II. Automation in engineering - power generation, power engineering.** (Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti). 1985. vp. (CONF-8506352—Pt.2). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87780126/JAW.

From AUTOS '85: conference on automation in engineering; Plzen, Czechoslovakia (18 Jun 1985).

Separate abstracts have been prepared for papers from part III of the proceedings from this conference on automation in power engineering. The conference was held in Czechoslovakia, June 18-21, 1985.

752 **(INIS-mf—10908) AUTOS '85. Part III. Automation in engineering - power generation, power engineering.** (Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti). 1985. vp. (CONF-8506352—Pt.3). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87780127/JAW.

From AUTOS '85: conference on automation in engineering; Plzen, Czechoslovakia (18 Jun 1985).

Separate abstracts have been prepared for papers from part III of the proceedings from this conference on automation in power engineering. The conference was held in Czechoslovakia, June 18-21, 1985.

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 766, 794, 811

753 **(CONF-871101—28) The new interactive CESAR.** Fox, P.B.; Yatabe, M. (Oak Ridge National Lab., TN (USA); Lawrence Livermore National Lab., CA (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE87011935/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

In this report the Nuclear Criticality Safety Analytical Methods Resource Center describes a new interactive version of CESAR, a critical experiments storage and retrieval program available on the Nuclear Criticality Information System (NCIS) database at Lawrence Livermore National Laboratory. The original version of CESAR did not include interactive search capabilities. The CESAR database was developed to provide a convenient, readily accessible means of storing and retrieving code input data for the SCALE Criticality Safety Analytical Sequences and the codes comprising those sequences. The database includes data for both cross section preparation and criticality safety calculations. 3 refs., 1 tab.

754 **(JAERI—1303) Benchmark calculations by the nuclear criticality safety analysis code system JACS(MGCL, KENO-IV).** Nomura, Yasushi; Katakura, Jun-ichi; Naito, Yoshitaka; Komuro, Yuichi; Okuno, Hiroshi. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 167p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE87703600/JAW.

Since 1980, as many as 1394 cases of benchmark calculations on criticality problems have been performed by the KENO-IV Monte Carlo calculation code with the MGCL cross section data library. The code system is a part of the criticality safety evaluation code system JACS developed at JAERI. The code validation results have been published in a series of JAERI-M reports and others. This report summarizes these results and the reliability of the code system systematically. The number of the calculated cases briefly described in this report together with their experimental systems and data are 502 for 17 kinds of homogeneous single-unit systems, 331 for 8 kinds of homogeneous multi-unit systems and 561 for 16 kinds of heterogeneous systems. Discussions and interpretations are made on the calculated k/sub eff/'s (neutron multiplication factors) with their bias errors. The factors related to the bias errors are confirmed together with their causes and trends.

755 **(JAERI-M—86-179) Experiments on subcriticality monitor.** Tsuji, Nobumasa; Osugi, Toshitaka; Ohno, Akio. (Japan Atomic Energy Research Inst., Tokyo). Dec 1986. 47p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703609/JAW.

Measurements of count rate ratio R of pair detectors were done at different subcritical states in the FCA XII-1 and XIII-1 cores. Fission counters of /sup 235/U, /sup 237/Np and /sup 238/U, and /sup 3/He proportional counter were coupled and were used as pair detectors in which each detector has different energy sensitivity for neutron energy. As a result, it was demonstrated that there exist some detector combinations and setting points for pair detector of which count rate ratio R changes smoothly versus subcriticality.

756 **(JAERI-M—87-089) One-dimensional, one-group diffusion calculation program based on analytic solutions for on-site core simulations, SICO1D.** Itagaki, Masafumi. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750306/JAW.

A one-dimensional one-group neutron diffusion program SICO1D has been developed to predict some core safety parameters such as linear heat rate and DNBR by means of an on-site minicomputer. This program is based on analytic solutions of the one-group diffusion equation, and a type of shooting method is used in determining the critical eigenvalue and the corresponding flux distribution. The integral contained in the W-3 DNB-correlation, known as the F-factor, is performed analytically by the use of analytic representation of axial power distribution. Present report describes the program performance, the physical model used in SICO1D, and the input data format. The input and output of a sample problem for the MUTSU reactor core are also shown to help user's understanding. Some test calculations for the reactor of nuclear ship MUTSU are made to compare the results obtained by SICO1D with those by the convential fine-mesh program CITATION.

757 **(JAERI-M—87-092) Neutron cross section data in multigroup constant library MGCL for criticality safety analysis.** Komuro, Yuichi; Tsunoda, Hirokazu; Sakurai, Jun. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 118p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750311/JAW.

Japan Atomic Energy Research Institute (JAERI) has been developing a criticality safety code system JACS, which consists of multigroup constant library MGCL, some transport theory programs and some programs processing nuclear data. The MGCL was constructed by MGCL-ACE, one of processing program in JACS, from the evaluated nuclear data file ENDF/B-IV. The program MAIL processes data in the MGCL and generates an effective macroscopic cross section set for transport programs, KENO-IV, ANISN and so on. The MGCL consists of one- and two-dimensional data. The infinite dilute cross section and Bondarenko-type self shielding factors (as a function of background cross section σ/sub 0/) of various reactions for each nuclide are tabulated in the one-dimensional cross section data. This report gives graphs on neutron energy dependency of the infinite dilute cross sections (total, fission, capture, elastic, inelastic and (n,2n) reaction) for all nuclides stored in the MGCL with 137 energy groups and with temperature of 300 K.

758 **(Juel—2116) Reactor physics concept for a low enriched compact core.** Schaal, H.; Vidovszky, I. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Feb 1987. 45p. NTIS, PC E07; NTIS as TIB/B87-11114.

For a cylindrical compact core with fuel plates ordered in evolventic form and fueled with low enriched uranium, embedded in a D/sub 2/O tank, series of sensitivity studies were performed to achieve the criticality value k/sub eff/ as high as possible for fresh fuel core. Parameters studied are e.g. uranium amount, uranium enrichment, diameter of the core, cooling medium. The calculations were done using the Monte Carlo code MORSE in a modified version.

759 **(KFK—4133) Updated FORTRAN-77 version of the 2-D static neutron transport code DIAMANT2 for regular triangular geometry.** Kuefner, K.; Burkhard, J.; Heger, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jun 1987. 160p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE87753313/JAW.

This report describes a major revision of the DIAMANT2 code, which evolved from the DIAMANT-code. DIAMANT2 solves the static multigroup neutron transport equation in planar geometry using the S/sub N/-method. Spatial discretization is accomplished by taking finite differences on a meshgrid composed of equilateral triangles. This new version of DIAMANT2 is written in FORTRAN 77 and designed to run on scalar and vector computers. This report contains a detailed documentation of the program and the input description as well as some experiences gained with the code on several vector computers.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 813, 819, 880, 893

760 **(CEA-CONF—8867) Tightness and mechanical behavior of bolted joints under thermal transients.** Guiroy; Grandoulier; Sauvadon, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Oct 1986. 22p. (In French). (CONF-8610269—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752911/JAW.

From 5. national congress on pressure apparatus technology; Paris, France (22 Oct 1986).

Bolted-flange assemblies of pressure apparatus are generally dimensioned according to the rules defined in codes such as CODAP, RCCM, ASME III, British Standards, ..., which take into account only mechanical loads applied to the assembly. These rules are not sufficient and do not allow to guarantee tightness of these assemblies in service when they are subject to thermal loads which may involve differential thermal expansions and deformations important with regard to mechanical loads. Such deformations may involve considerable change of internal efforts and more particularly bolt screwing and pressures applied on the joints, and consequently induce a possible loss of tightness. The present paper aims at quantifying these phenomena from tests carried at the CEA Saclay on a tubular heat exchanger, under strong thermal shocks, to study their relation with the assembly tightness, and to test a design improvement which may elastically absorb differential thermal expansions.

761 **(EPRI-NP—5400) Micromorphology and microchemistry of corrosion products in tubesheet crevices: Final report.** Gibbon, D.L.; Varsanik, R.G. (Calgon Corp., Pittsburgh, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 69p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920039/JAW.

Microchemical and micromorphologic examinations have been made on tubes of mill annealed alloy 600. On one tube, intergranular attack (IGA) was very light; major attention was directed instead to the denting magnetite formed by alkali in the tube-tubesheet crevice. Magnetite at the top of the tubesheet is coarsely crystalline at the Inconel contact surface (ICS), with large open channels available for passage of liquid phases. Na, Si, and S are major constituents of crystalline phases with magnetite. The second tube exposed to alkaline silicate showed very little IGA, while the third tube exposed to alkaline sulfate showed from 200 to 300 micrometers of attack. The final sample included both tube and tubesheet. The crevice was filled with magnetite and (Na, P)-rich needle-like crystals. Cr, Ni, Ti, Ca, Cl, S, P, Si, K and Na are all found in addition to the expected Fe. The tube scale is highly porous. IGA affects approximately 60% of the tube wall thickness. The intergranular surfaces in the tube are commonly covered with easily seen films/deposits. 2 refs., 26 figs., 5 tabs.

762 **(EPRI-NP—5439) Fracture toughness characterization of thermally embrittled cast duplex stainless steel: Final report.** McConnell, P.; Sheckherd, B. (Fracture Control Corp., Goleta, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 75p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920028/JAW.

Cast duplex stainless steel, grade "CF3", used in nuclear pump applications, was thermally aged to induce an embrittling phase transformation. The mechanical properties of as-cast material and materials thermally aged to simulate long term exposure at 280°C (536°F) were investigated. Fracture toughness, Charpy V-Notch (CVN), tensile, precracked CVN, nil-ductility transition temperature, and hardness tests were performed on these materials. Tests were run as a function of temperature and loading rate. The as-cast structure of this duplex stainless steel is extremely tough, but thermal aging causes a decreased upper shelf fracture toughness and absorbed energy and a marked increase in transition temperature. However, even the most severely aged material (7320h/400C) appears to possess excellent properties. A tentative conclusion is that this cast duplex stainless steel is sufficiently tough, even in the aged condition, to resist crack initiation and propagation under expected nuclear pump service conditions.

763 (INIS-mf—11002, pp 177-183) **Simulation of water self-cleaning processes in NPP cooling pools.** Egorov, Yu.A.; Kazakov, S.V.; Leonov, S.V.; Staurin, N.V. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Radiation conditions in NPP water cooling pool are considered. The problem is analyzed by means of mathematical simulation of radionuclide accumulation and transport in water and aquatic ecosystems of the cooling pool. The water self-cleaning effect resulting from a number of processes (filtration through th e bottom and surrounding dams, sedimentation, radionuclide absorption by hydrobionts and so on) has been taken into account via introduction of a single integral parameter called the self-cleaning constant. Its value was determined by gradient identification methods on the basis of experimental data obtained from long-time period of observations on the radionuclide dynamics in the cooling pool water. The self-cleaning constant values and half-removing periods for Cs-137, Co-60 and Mn-54 are given. 4 refs.; 1 tab.; 3 figs.

764 **(INIS-mf—11029) Temperature metrology '86.** (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky). 1986. 17p. (In Czech and Slovak). (CONF-8605302—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700236/JAW.

From National conference on temperature metrology; Hradec Kralove, Czechoslovakia (19 May 1986).

The national conference was oriented to problems related to the calibration of thermometers and to correct measurement of temperature in workshops and laboratories, within the range of -200 to +3000 degC, and to contact thermometers. The application of metrology of temperature in nuclear power plants was discussed in two papers: Effect of nuclear reactor environment on thermoelectric sensor readings, and Calibration of temperature sensors in a nuclear reactor. (J.B.).

765 **(JAERI-M—86-162) Survey of heat-pipe application under nuclear environment.** Tsuyuzaki, Noriyoshi; Saito, Takashi; Okamoto, Yoshizo; Hishida, Makoto; Negishi, Kanji. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 53p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703603/JAW.

Heat pipes today are employed in a wide variety of special heat transfer applications including nuclear reactor. In this nuclear technology area in Japan; A headway speed of the heat pipe application technique is not so high because of safety confirmation and investigation under each developing step. Especially, the outline of space craft is a tendency to increase the size. Therefore, the power supply is also tendency to increase the outlet power and keep the long life. Under SP-100 project, the development of nuclear power supply system which power is 1400 - 1600 KW thermal and 100 KW electric power is steadily in progress. Many heat pipes are adopted for thermionic conversion and coolant system in order to construct more safety and light weight system for the project. This paper describes the survey of the heat pipe applications under the present and future condition for nuclear environment.

766 **(JAERI-M—87-067) DABIE: a data banking system of integral experiments for reactor core characteristics computer codes. User's manual.** Matsumoto, Kiyoshi; Naito, Yoshitaka; Ohkubo, Shuji; Aoyanagi, Hideo. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 136p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750046/JAW.

A data banking system of integral experiments for reactor core characteristics computer codes, DABIE, has been developed to lighten the burden on searching so many documents to obtain experiment data required for verification of reactor core characteristics computer code. This data banking system, DABIE, has capabilities of systematic classification, registration and easy retrieval of

experiment data. DABIE consists of data bank and supporting programs. Supporting programs are data registration program, data reference program and maintenance program. The system is designed so that user can easily register information of experiment systems including figures as well as geometry data and measured data or obtain those data through TSS terminal interactively. This manual describes the system structure, how-to-use and sample uses of this code system.

767 **(LNCC—009/87) Seismic analysis of a containment vessel.** Toledo, E.M.; Jospin, R.J.; Loula, A.F.D. (Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro (Brazil)). 1987. 20p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703768/JAW.

A seismic analysis of a nuclear power plant containment vessel is presented. Usual loads in this kind of analysis like SSE, DBE and SSB loadings are considered. With the response spectra, previously obtained, for the above mentioned loadings one uses the response spectrum techniques in order to obtain estimatives for the maximum values of the stresses. Some considerations about the problem and the approcah used herein, are initially described. Next, the analysed structure geometry and some results, compared with those obtained by using computer code ANSYS are shown.

768 **(SAND—87-0123C) Analysis of a stiffener intersection eccentricity in a steel containment.** Rogers, J.D.; Greimann, L.F. (Sandia National Labs., Albuquerque, NM (USA); Ames Lab., IA (USA)). 1987. Contract AC04-76DP00789. 20p. (CONF-8708130—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000193/JAW.

From SMIRT-post conference on nuclear robotics; Lausanne, Switzerland (24 Aug 1987).

A 1 : 8-scale steel containment model was fabricated, analyzed, and pressurized to failure by Sandia National Laboratories. Details of the containment construction are given and the analysis and testing are described in detail. During testing, the containment model ruptured. The failure is believed to have initiated near Equipment Hatch 1 and was attributed to a 1/2 in. eccentricity in a stiffener intersection detail. Post-test analysis of this detail was performed by Sandia using the MARC general purpose finite element analysis program. This analysis indicates a significant strain concentration in the 1/2 in. eccentricity. In the current work, a portion of the as-built 1 : 8-scale model surrounding Equipment Hatch 1 was analyzed using the ANSYS general purpose finite element program to verify the Sandia post-test analysis and to qualify the ANSYS program. Additionally, reduced size models of the failure region and of the corresponding region of a model with altered geometry were analyzed. The use of the ANSYS program was based on accessibility and cost considerations. This program has many of the features required for this analysis such as plasticity and large displacements.

769 **Evaluation of intergranular cracks on the ring header cross at Grand Gulf Unit No. 1.** Czajkowski, C.J. (Brookhaven National Lab., Upton, NY, USA). *International Journal of Pressure Vessels and Piping;* **27**: No. 5, 353-365(1987). Contract AC02-76CH00016.

A metallurgical investigation was performed on a sample of cracked ring header cross material from the Grand Gulf Unit No. 1 Nuclear Power Station. The cracks were located in a 6-7 in (15-17.5 cm) width band running circumferentially below the cross to cap weld with a similar band above the cross to discharger pipe weld. The indications were up to 19 mm in length and 6.0 mm in depth. This particular sample was cut from a cross which had not seen actual service but which had been used to qualify the induction heating stress improvement (IHSI) technique for the Grand Gulf units. The base material was SA 182 material manufactured to SA 403-type WP 304 stainless steel. The investigation consisted of visual/dye penetrant examination, chemical analysis, hardness testing, optical microscopy, scanning electron microscopy and energy dispersive spectroscopy. The evaluated cracks were intergranular and initiated on the forging's exterior surface. The grain size of the material was larger than ASTM 00 and no definitive corrosive species were found by Energy Dispersive Spectroscopy (EDS). The cracking is considered to be the result of the forging having been overheated/burned during manufacture.

770 **US developments in NDE for steam generators.** Birks, A.S.; Brown, S.D.; Curtis, A.E. III; Welty, C.S. Jr. (Battelle Pacific Northwest Lab., Richland, WA, USA; Westinghouse Electric Corp., Pittsburgh, PA, USA; Rochester Gas and Electric Corp., NY, USA; Electric Power Research Inst., Palo Alto, CA, USA). *International Journal of Pressure Vessels and Piping;* **28**: No. 1-5, 203-207(1987).

A summary is given of the more important developments of the past 1-3 years, which had an impact on steam generator NDE. Industrial research efforts directed at responding to the developments, and at achieving improvements in inspection technology are described.

771 **Procedure for flaw detection in cast stainless steel.** Kupperman, D.S. (to Dept. of Energy). US Patent Application 6-902,912. 29 Aug 1986. 20p. Contract W-31109-ENG-38. DE88000866 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000866/JAW.

This paper describes a method of ultrasonic flaw detection in cast stainless steel components incorporating the steps of determining the nature of the microstructure of the cast stainless steel at the site of the flaw detection measurements by ultrasonic means independent of the component thickness at the site. Then, choosing from a plurality of flaw detection techniques, one such technique appropriate to the nature of the microstructure as determined is discussed. The detection of flaws by means of the chosen technique is then detailed.

772 **Dynamic analyses of a crack run-arrest experiment in a nonisothermal plate.** Bass, B.R.; Pugh, C.E.; Stamm, H.K. (Heavy-Section Steel Technology Program, Oak Ridge National Lab., Oak Ridge, TN). pp 175-184 of Proceedings of the 1985 pressure vessels and piping conference. Volume PVP-98-2. Pressure vessel components design and analysis. Gawaltney, R.C. New York, NY; American Society of Mechanical Engineers (1985). (CONF-850670—). Contract AC05-84OR21400.

From ASME Pressure Vessel and Piping Division conference; New Orleans, LA, USA (24 Jun 1985).

In crack-arrest studies sponsored by the Heavy-Section Steel Technology (HSST) Program, a primary objective has been to produce fracture toughness data for reactor pressure vessel materials at temperatures approaching the Charpy upper-shelf regime. Wide-plate tests being conducted at the National Bureau of Standards for the HSST Program are providing an opportunity to obtain significant numbers of data points at affordable costs. In these tests, a single-edge crack in a wide-plate which is subjected to tensile loading initiates at low temperatures and arrests in a region of increased fracture toughness. The plate geometry, the material properties, and the instrumentation are discussed along with conditions and results for this test. Pretest static and elastodynamic analyses are described, and posttest analyses based on actual boundary conditions are shown to compare favorably with the observed nonarrest events.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 794

773 **(CEA-CONF—8892) Pulsed magnetic welding application of fast breeder austenitic pins plugging.** Gallizzi, H.; Colombe, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Nov 1986. 11p. (In French). (CONF-8611183—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752928/JAW.

From Magnetic forming conference; Grenoble, France (27 Nov 1986).

For specific nuclear needs, we had to develop pulsed magnetic welding on high resistivity coefficient alloys as austenitic steels. The magnetic force produced by an explosive inductor is transmitted on weld pieces by the use of an aluminium driver. A theoretical work carried out permitted to compare pulsed magnetic welding with explosive welding. With specific recordings, it was

possible to study electrical and magnetical behavior during the active welding phase. By means of these informations, we are able to specify and to realize, with the financial help of ANVAR organization, a low impedance high velocity generator permitting to weld with a non destructible inductor. 6 references.

774 **(FRCEA-TH—26) Tritium distribution between the fuel can and the oxide of fuel elements of light-water reactors.** Masson, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif; Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France)). Dec 1986. 150p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752739/JAW.

The study on the measurement of tritium and other radionuclide contained in zircaloy fuel cans of the water cooled reactor fuel elements had two aims: the first was to estimate with accuracy the distribution of tritium in a fuel element (can + oxide). The measurement of tritium in the zircaloy fuel cans of the BORSSELE fuel elements associated with the measurement of tritium in the oxide allowed the establishment of a complete tritium balance on an industrial spent fuel element. This result has been compared to the values calculated by the code CEA/SEN and will allow to validate or adjust this calculation. The second aim delt with the characterization of the other radionuclides gaseous (Kr85) or not (Cs 134 and 137) contained in the solid zircaloy wastes (hulls) coming from the industrial reprocessing of "water cooled" fuel elements. These activity measurements in the hulls allowed to estimate the residual content of tritium, Kr 85 and other radionuclides which may be found in these solid wastes (high-level $\beta\gamma$ radioactive wastes). Original experimental methods have been developed to reach these aims (dissolution in ammonium bifluoride medium and quantitative recovery of gases produced, radiochromatography, and liquid scintillation after double distillation). One tries to explain the presence of Kr 85 in the irradiated can.

2204 Control Systems

REFER ALSO TO CITATION(S) 799, 823, 865, 871, 872, 881, 896, 898

775 **(FRNC-TH—3020) Pressurized water reactor monitoring. Study of detection, diagnostic and estimation methods (least error squares and filtering).** Gillet, M. (Aix-Marseille-1 Univ., 13 - Marseille (France)). Jul 1986. 156p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87752741/JAW.

This thesis presents a study for the surveillance of the "primary coolant circuit inventory monitoring" of a pressurized water reactor. A reference model is developed in view of an automatic system ensuring detection and diagnostic in real time. The methods used for the present application are statistical tests and a method related to pattern recognition. The estimation of failures detected, difficult owing to the non-linearity of the problem, is treated by the least error squares method of the predictor or corrector type, and by filtering. It is in this frame that a new optimized method with superlinear convergence is developed, and that a segmented linearization of the model is introduced, in view of a multiple filtering.

776 (IAEA-TECDOC—424, pp 171-186) **Automated on-line surveillance and monitoring systems for early identification of incipient failures in nuclear power plants.** Federico, A.G.; Ragona, R. (ENEA, Rome, Italy). Jun 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700184/JAW. (CONF-8605303—Summ.).

From Technical committee meeting on the identification of failure sequences sensitive to human error; Vienna, Austria (5 May 1986).

The parallel growth of technologies in transducers, measurement methods, digital signal processing and computing devices is the framework for the actual trend toward the development of built-in surveillance and monitoring systems that, from the incoming operational data, can infer the status of a plant and indicate significant deviations from normality. This paper presents an outline of the stages necessary to develop a complete real time on-line surveillance system. The prototype here described was developed for an operating BWR Nuclear Power Plant. A special attention is devoted to the principles of the system design, to the models that are to be implemented and to the use of techniques in decision making. The role of human operator is quoted versus the increasing amount of tasks performed by the digital computers and by advanced instrumentation. Some considerations are given about the results obtained from a system for Stability Monitoring of the BWR core and on design criteria of a Pattern Recognition based Surveillance System implemented by ENEA for an operating BWR plant. 13 references, 9 figures.

777 (NEI-FI—1, pp 7.2.1-7.2.12) **Review of some aspects of human reliability quantification.** Lydell, B.O.Y.; Spurgin, A.J.; Hannaman, G.W.; Lukic, Y.D. (NUS Corporation, San Diego, CA USA). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

An area in systems reliability considered to be weak, is the characterization and quantification of the role of the operations and maintenance staff in combatting accidents. Several R and D programs are underway to improve the modeling of human interactions and some progress has been made. This paper describes a specific aspect of human reliability analysis which is referred to as modeling of cognitive processes. In particular, the basis for the so-called Human Cognitive Reliability (HCR) model is described and the focus is on its validation and on its benefits and limitations.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 393, 394, 825, 854, 855, 894, 901, 902, 903, 904, 905, 906, 911, 916, 916, 961, 1623, 1744

778 **(INIS-BR—809) Metamorphic history at Lagoa Real: implications for uranium mineralization.** Lobato, L.M. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). [1987]. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703550/JAW.

Metasomatism and attendant mineralization associated with shear zones have beem recently studied in detail by several investigators. It has emerged from these studies that whereas ground preparation by shearing is essential to the percolation of mineralizing solutions, the ultimate Loci of mineralization reflect chemical controls via fluid/rock interactions. Uranium mineralization at Lagoa Real can be conveniently understood through this perspective. (E.G.).

779 **(INIS-mf—10972) Selection of sites for nuclear power plants in The Netherlands. Pt. A. Policy proposal.** (Ministerie van Economische Zaken, The Hague (Netherlands); Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands); Ministerie van Sociale Zaken en Werkgelegenheid, The Hague (Netherlands)). 11 Jan 1985. 80p. (In Dutch). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703563/JAW.

In this report a policy proposal is presented concerning the selection of location sites for new nuclear power plants in the Netherlands. Firstly it is investigated which of the 29 already selected location sites are not to be taken into further account because of obvious obstructions (close vicinity of a big city etc.). The remaining sites are judged on the base of local population magnitude. The sites that pass the last criteria are relatively compared from a large number of viewpoints. To round off the selection procedure the government will explain why they consider the finally selected sites to be suitable for location of new nuclear power plants. Steps are indicated to prevent the decrease of planologic suitability of the selected location sites. (Auth.). Tweede Kamer, vergaderjaar 1984-1985, 18830, nrs. 1-4; 19 figs.; 14 tabs.

780 (INIS-mf—10973) **Selection of sites for nuclear power plants in The Netherlands. Pt. C. Recommendations.** (Raad van Advies voor de Ruimtelijke Ordening, The Hague (Netherlands); Voorlopige Wadden Adviesraad (Netherlands)). 17 Jan 1986. 130p. (In Dutch). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703564/JAW.

This advice is concerned with the question where possible new nuclear power plants can at best be sited in the Netherlands. Safety risks of power plants are considered (sourceterm analysis, meteorologic aspects). A site analysis is presented on the base of criteria like population density, possible emergency provisions, contamination of agricultural areas etc. Reports of several committees are included. (Auth.). Tweede Kamer, vergaderjaar 1985-1986, 18830, nrs. 43-44; 10 figs.; 38 tabs.

781 (INIS-mf—10974) **Selection of sites for nuclear power plants in the Netherlands. Pt. D. Governmental resolution.** (Ministerie van Economische Zaken, The Hague (Netherlands); Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands); Ministerie van Sociale Zaken en Werkgelegenheid, The Hague (Netherlands)). 27 Jan 1986. 68p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703565/JAW.

This report presents a summary of the Dutch governmental decree concerning site selection of new nuclear power plants. It also includes the explanatory memorandum of the decree. It goes into the procedure followed, into safety aspects, population density criteria, calamities, environment, economic aspects, cooling water etc. Specific aspects of 5 proposed sites are reviewed. (G.J.P.). Tweede Kamer, vergaderjaar 1985-1986, 18830, nrs. 46-47; 10 figs.; 7 tabs.

782 (INIS-mf—10999) **Welfare and evacuation sub-plan: APTCARE - Lucas Heights.** (New South Wales State Emergency Services, Sydney (Australia)). Nov 1985. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700119/JAW.

Also know as: Evacuation and welfare sub-plan to APTCARE.

This Sub-plan has been prepared as a contingency plan to the APTCARE document - A plan to cope with an accident at the Australian Atomic Energy Commission's Research Establishment at Lucas Heights. It details procedures to be followed for the evacuation and welfare of citizens residing in areas outside the Commission's establishment in the event that their health or safety is threatened by reason of an accident at the nuclear reactor facility which could have off-site implications. Additionally, it lists roles and tasking assignments of various counter-disaster response and support agencies in such an occurrence.

783 (INIS-mf—11001, pp 45-53) **Some aspects of activated carbon selection for radioactive iodine adsorption.** Kshesnyak, E.V.; Kraevski, P.; Tomashek, M. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A method is suggested and technology developed for testing the activated carbon applicability for iodine filters. Testing results are presented for the air clean-up both under NPP normal operation conditions and during accidents. The activated carbon produced in Poland is compared with the imported one with respect to its integral and differential efficiency of CH/sub 3//sup 131/I adsorption. 7 refs.; 2 tabs.; 1 fig.

784 (INIS-mf—11001, pp 17-33) **Investigation of the noble gas compositions in NPP gaseous releases.** Loennig, M.; Kuemmel, M.; Obrikat, D.; Zeekhaver, R.; Majer, V. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Calculations results of noble gases content in the air released from NPP with WWER type reactor are presented for various stages of the plant operation. The results are compared with experimental data obtained by a gamma-spectrometric study, the revealed differences are discussed. The following radioactive noble gases have been identified in the air released from the stack:/sup 133/Xe, /sup 135/Xe, /sup 85/Kr, /sup 87m/Kr, /sup 41/Ar. 9 refs.; 6 tabs.; 3 figs.

785 (INIS-mf—11001, pp 34-37) **Measuring device for permanent and selective determination of noble gases in NPP ventilation stack releases.** Deshi, Sh. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Equipment for measuring radioactive noble gases concentration in NPP ventilation stack releases is described. Measuring is done by a germanium semiconductor detector placed in a chamber with low background. The obtained data are processed by gamma-spectroscopy method with the use of a system consisting of a CAMAC type multichannel analyzer connected with a minicomputer.

786 (INIS-mf—11001, pp 38-44) **Problems of radiactive iodine isotopes releases and damping from nuclear reactors in INR, Swierk.** Filipyak, B.; Kostyrko, A. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Iodine monitoring methods and results are presented for 'Eva' and 'Maria' reactors within 1978-1980. Investigation methods of iodine adsorbers efficiency in the ventilation systems of nuclear installations during operation are analyzed, the results of investigations on WWER-C 'Eva' reactor are given. Suggested possibilities of new iodine absorber materials application for analytical and technological purposes are discussed. Standard sorbents have been analyzed from the viewpoint of different iodine forms sorption. Methods for the sorbing filter materials regeneration with the use of special soaking compounds are presented. 5 refs.; 5 tabs.

787 (INIS-mf—11001, pp 107-118) **Detectors for radionuclides monitoring on NPP technological circuits.** Antonov, V.L.; Gruzdeva, A.A.; Zhernov, V.S.; Kozlov, S.K.; Lapshev, O.B.; Matveev, V.V.; Pushkin, V.V.; Romanichev, M.K.; Shermakov, A.E.; Vargin, E.P. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Location scheme for technological and radiometric monitoring points on the primary and secondary circuits of NPP with WWER-440 and WWER-1000 is presented. A mathematical model is described for propagation of gaseous and non-volatile radionuclides, contained in the primary circuit coolant, over the secondary circuit communications in case of one steam generator fightness loss. Basing on this model the medium volumetric radioactivity has been calculated at the monitoring points both for the normal state of the reactor core and for the state when 1% of the fuel elements have microcracks of the gas leakage type and 0.1% of them have open uranium surface. Major characteristics and short descriptions are given of the detectors for the medium volumetric radioactivity monitoring that are employed for the radiation technological inspection of the primary and secondary circuits. The minimun primary circuit coolant leakages have been determined that can be detected. 4 refs.; 7 figs.

788 (INIS-mf—11002, pp 36-38) **Determination of I-131 content in children's and cow's thyroid in Kozloduj NPP region.** Filev, G.; Vasilev, G.; Khristova, M. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Within the scope of general programme for the radiation safety investigations the I-131 content in thyroid has been measured. For this purpose a group of 20 children within the age of 8-12

supplied with milk from private cows was selected as well as a group of dairy cows of local breed during milking period. Both groups were selected in a village located at 4km from the NPP in the direction of the dominating winds. According to the measuring results both the separate and average count rates for the two groups did not differ from the background ones. 4 refs.

789 (INIS-mf—11002, pp 166-171) **Simulation of NPP radioactive releases spreading in the atmosphere.** Bruyatskij, E.V.; Egorov, Ya.A.; Ivanov, E.A.; Ramzina, T.V. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

An approach towards simulation of spreading in the atmosphere of floating radioactive releases from high NPP stacks is described. The mathematical model has been realized in COMEAN-2 code written in ALGOL for BEhSM-6 computer. 5 refs.

790 (INIS-mf—11002, pp 172-176) **Calculation and experimental study of radioactive release spreading within the inspected zone of a NPP.** Achkasov, S.K.; Badyaev, V.V.; Egorov, Yu.A.; Ivanov, E.A.; Krasnozhen, G.N.; Korobejnikov, V.L.; Nekrasov, V.I.; Ramzina, T.V. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Experimental results are presented in comparison with calculation data obtained with a jet/diffusion model of admixture spreading in the atmosphere. The complex experiment has demonstrated the jet/diffusion approach to be sufficiently good for the process description and the developed mathematical model applicable for determining the expected near ground radionuclide concentrations connected with NPP gaseous radioactive releases. At the radioactive noble gas release rate of 1.85x10/sup 13/Bq/day (the maximum permissible value for 1 GW NPP) through 150 m stack the near ground RNG concentration within the inspected zone is about 10/sup -5/Bq/l. 3 refs.; 2 tabs.

791 (INIS-mf—11002, pp 39-40) **Investigation of gamma-radiation background in the vicinity of Kozloduj NPP.** Vasilev, G.; Khristova, M. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Results of gamma-radiation background dose rates measurements are presented since before Kozloduj NPP start-up (1968-1974) and during its operation within 1974-1981. The measurements were carried out at the plant site (3km radius), within the adjacent inspected zone (12 km radius), within the zone along the dominating wind direction (up to 80 km from the NPP) and at some reference points out of the latter. In total 17 measurement series were performed for 400 points. 2 refs.

792 **(NAGRA-NTB—83-26) Stripa Project. Annual report 1982.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Apr 1983. 36p. Nagra, CH-5401 Baden, Switzerland.

The Stripa Project is an international project being performed under the sponsorship of the OECD Nuclear Energy Agency (NEA). The Project concerns research related to the disposal of highly radioactive waste into crystalline rock. The KBS Division of the Swedish Nuclear Fuel Supply Company (SKBF) has been entrusted with the management of the Project, under the direction of representatives from each participating country. The aim of this report is to inform the OECD Nuclear Energy Agency, and participants in the Project, about the general progress of work during 1982.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 741, 758, 819, 823, 862, 909, 926

793 **(CONF-871036—7) HFIR [High-Flux Isotope Reactor] irradiation facilities improvements: Completion of the HIFI [High Irradiation Facilities Improvements] project.** Thoms, K.R.; Hicks, G.R.; Montgomery, B.H.; Siman-Tov, I.I.; West, C.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000582/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

The HFIR Irradiation Facilities Improvements (HIFI) Project has now been completed. In August 1986, Phase I of the project was completed, providing the capability to perform instrumented irradiation experiments in the target region of the HFIR. In June 1987, Phase II of the project was completed with the assembly in the reactor mockup of all the components necessary to operate up to eight 46-mm-diam instrumented experiments in the removable beryllium region of the HFIR. In conjuntion with the installation of Phase I components, the first instrumented target capsule was installed to determine more accurately the probable temperature in the uninstrumented target capsules previously irradiated as part of the Japan/US fusion materials program. Data from this experiment indicate close agreement with expected temperatures in all positions except those at the extreme ends of the capsule. These data provide a more accurate axial gamma heating rate profile that will allow for better design of future HFIR target irradiation capsules.

794 **(EIR—608) Measurements and analyses pertaining to the PROTEUS-LWHCR phase I (1981-82) programme.** Chawla, R.; Gmuer, K.; Hager, H.; Seiler, R. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Dec 1986. vp. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87780114/JAW.

The reference tight-pitch lattice consisted of two rod types, with an average fissile-plutonium enrichment of 6% and a fuel/moderator ratio of 2.0. The moderators were H_2O, Dowtherm (simulating an H_2O voidage of 42.5%), and air (100% void). The subsequent more detailed comparisons between experiment and calculation should provide a useful basis for resolving the conflicting calculational results that have been reported in the past for the void coefficient characteristics of LWHCRs.

795 **(FRCEA-TH—17) Study of cold and hot sources in a research reactor. (Physics, specifications, operation, utilization).** Safieh, J. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1982. 271p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE87752743/JAW.

A brief description of the reactor, sources and experimental channels (ORPHEE being taken as example) is first given. The first part deals with the hot neutron source, mainly made of a graphite block to be carried at a temperature of 1500/sup 0/K by nuclear heating. The present study focused on the determination, with the code MERCURE IV, of heat sources generated in the graphite block. From these results the spatial distribution of temperatures have been calculated with two different methods. Mechanical and thermal stresses have been calculated for the hot points. Then, the outlet neutron spectra is determined by means of the code APOLLO. Finally, the operation of the device is presented and the risks and the safety measures are given. The second part deals with cold neutron sources comprising mainly a cold moderator (liquid hydrogen 20.4/sup 0/K). The helium coolant circuit liquefies the hydrogen by means of heat exchange in a condenser. Cold neutron yields calculations are developed by means of the code THERMOS in the plane and cyclindrical geometries. Heat sources generated by nuclear radiations are calculated. A detailed description of the device and its coolant circuit is given, and a risk analysis is finally presented. The third part deals with the part of thermal cold and hot neutrons in the study of matter and its dynamics. Technical means needed to obtain a monochromatic beam, for diffraction ex-

periments, are recalled emphasizing on the interest of these neutrons with regard to X radiation. Then, one deals with cold neutron guides. Finally, the efficiency of two neutron guides is calculated. 78 refs.

796 (IAEA-TECDOC—409, pp 227-233) **Nondestructive studies in metallurgy using neutrons.** Dimic, V. (Institut Jozef Stefan, Ljubljana, Yugoslavia). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

Nondestructive techniques and studies in metallurgy using the 250 kW TRIGA reactor at the Jozef Stefan Institute are described. The techniques include neutron radiography including a high resolution radiographic method called microneutronography, neutron induced autoradiography including use of solid state nuclear track detectors, texture and neutron diffraction, and small angle scattering of neutron. The utility of a low power research reactor in these studies is emphasized. 16 refs.

797 (IAEA-TECDOC—409) **Research reactor activities in support of national nuclear programmes. Proceedings of a technical committee meeting held in Budapest, Hungary, 10-13 December 1985 and selected papers from a seminar on applied research and service activities for research reactor operations held in Copenhagen, Denmark, 9-13 September 1985.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1987. 413p. (CONF-8512139—; CONF-850932—). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW.

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

This report is the result of an IAEA Technical Committee Meeting on Research Reactor Activities in Support of National Nuclear Programmes held in Budapest, Hungary during 10-13 December 1985. The countries represented were Belgium, Finland, France, Federal Republic of Germany, German Democratic Republic, India, Poland, Spain, United Kingdom, United States, Yugoslavia and Hungary. The purpose of the meeting was to present information and details of several well-utilized research reactors and to discuss their contribution to national nuclear programmes. A related Agency activity, a Seminar on Applied Research and Service Activities for Research Reactor Operations was held in Copenhagen, Denmark during 9-13 September 1985. Selected papers from this Seminar relevant to the topic of research reactor support of national nuclear programmes have been included in this report. A separate abstract was prepared for each of 19 papers presented at the Technical Committee Meeting on Research Reactor Activities in Support of National Nuclear Programmes and for each of 15 papers selected from the presentations of the Seminar on Applied Research and Service Activities for Research Reactor Operations. Refs, figs and tabs.

798 (IAEA-TECDOC—409, pp 63-69) **Role of FIR-1 in the development of nuclear power in Finland.** Hiismaeki, P. (Valtion Teknillinen Tutkimuskeskus, Espoo, Finland). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

The Technical Research Centre of Finland operates the FIR-1, a 250 kW TRIGA reactor that was installed in 1962. The historical development of the utilization of the reactor is presented. With the introduction of nuclear power in Finland, the reactor centre has played a significant role in support of the programme. The main fields of activity presently are: Analytics - NAA of some 20,000 samples per year; development of laser resonance spectroscopy; Materials Research and Reactor Physics - mechanical testing of reactor materials; nuclear instrumentation and neutron diffraction; Nuclear Medicine - medical radioisotopes; Process Physics - use of radioactive tracers; Nuclear Waste Management. 1 tab.

799 (IAEA-TECDOC—409, pp 71-84) **Role of research reactors in the development of nuclear technology in the German Democratic Republic.** Klebau, J.; Ziegenbein, D. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden, German Democratic Republic). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

The GDR operates 5 research and training reactors: RFR, a 10 MW light water cooled and moderated reactor of the Soviet WWR-S type; RRR a zero power Argonaut type; RAKE a light water moderated and reflected tank type; ZLFR a 10 W tank type; AKR a 1 W solid homogeneous type. Activities include reactor physics, neutron diffraction, radioisotope production (40,000 packages per year), silicon transmutation doping, education and training. A computer based reactor control system is also described. 10 refs, 7 figs, 1 tab.

800 (IAEA-TECDOC—409, pp 85-103) **Utilization of the FRG-1 and FRG-2 research reactors.** Krull, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude, Germany, F.R.). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

Following a listing of the various research reactors in the FRG, the activities of the FRG-1 (5 MW and FRG-2 (15 MW)) at GKSS-Geesthacht are listed. These include energy research, reactor safety research, neutron scattering, activation analysis, neutron radiography, radioisotope production, gamma irradiation, silicon transmutation doping, education and economics. Figs.

801 (IAEA-TECDOC—409, pp 105-123) **Past and present uses of CEA Grenoble research reactors.** Garcin, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38, France. Service des Piles). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

The uses of the French Atomic Energy Commission (CEA) Grenoble research reactors are presented. The main features of the three swimming pool, open core, MTR type reactors, SILOE (35 MW), MELUSIN (8 MW) and SILOETTE (100 kW) are described. Their uses are described in historical order along with the important relevant reactor upgrading that permitted scientific and technological advance. Finally, the beneficial advantages of those research reactors common type are recalled, as demonstrated by their achievements. 16 refs, 7 figs, 5 tabs.

802 (IAEA-TECDOC—409, pp 163-176) **Educational and research activities of the nuclear training reactor of the Technical University Budapest.** Csom, G.; Levai, F.; Keoemley, G. (Budapesti Mueszaki Egyetem, Hungary). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

Simultaneously with the spread of the peaceful uses of atomic energy in Hungary, the need for training specialists in this field also at universities arose. In the middle of the sixties, it was decided that a nuclear reactor of low power should be established at the Technical University Budapest, first of all for educational purposes. The reactor went first critical in May 1971. In the paper, after briefly surveying the most important technical parameters of the reactor, having a maximum thermal power of 100 kW, our educational and research activities are summarized. 1 ref, 3 figs.

803 (IAEA-TECDOC—409, pp 177-183) **Research reactor activities in India.** Thaper, C.L. (Bhabha Atomic Research Centre, Bombay, India). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

So far, six research reactors of different designs and power levels have been built at the Bhabha Atomic Research Centre. These are the Aspara (1 MW), Cirus (40 MW), Zerlina (negligible), Purnima I (negligible), Purnima II (negligible), and Dhruva (100 MW). The Purnima I is plutonium fueled while Purnima II is fueled with U-233. The utilization of these reactors is described including design studies of small reactors, neutron beam research, radioisotope production, neutron activation analysis, reactor engineering, and education programmes. 2 figs.

804 (IAEA-TECDOC—409, pp 185-198) **Research reactors contribution in national nuclear programmes in Poland.** Koziel, J. (Institute of Atomic Energy, Otwock-Swierk, Poland). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139— ; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

The Polish Research Reactors EWA and MARIA are located in the Isotope Production and Reactor Centre/IPRC of the Institute of Atomic Energy. EWA-10 MW, was first put into service in 1958 as a 2 MW Research Reactor, designed especially for isotope irradiation and neutron beam experiments. It has been upgraded two times to achieve an actual power of 10 MW. MARIA-30 MW, is a material testing reactor with large capability of isotope irradiations. Some horizontal neutron beam tubes have been also designed. Nuclear power programme in Poland demands research support. MARIA is a particularly convenient reactor for loop experiments, so that two large loops are being under construction. The first one, for light water, PWR type reactor and the second is for fast breeder gas cooled reactor programme. Neutron beams of EWA and MARIA reactors are used for solid state investigation. For this reason several sorts of neutron spectrometers and diffractometers have been designed and constructed. Among different services, activation analysis and neutron doping of silicon are the most important. The spent fuel of MARIA reactor is a convenient gamma radiation source. It is used to sterilize some medical equipment. Such a wide range of the production and the services is to satisfy the national needs and is also the subject of exportation. 9 refs, 5 tabs.

805 (IAEA-TECDOC—409, pp 199-203) **Utilization of the JEN (Madrid) experimental reactors in support of the national nuclear program.** Alcober, V. (Junta de Energia Nuclear, Madrid, Spain). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

The Junta de Energia Nucleares installed a 2 MW, MTR type research reactor in 1958. Operation of the reactor was suspended in 1984. A historical review of the operation of the reactor is presented with some insight as to the causes of the reduction in utilization of the reactor. Some ongoing activities as well as plans for the future use of the JEN-1 are presented.

806 (IAEA-TECDOC—409, pp 205-214) **Scottish Universities Research and Reactor Centre.** Izatt, J.A. (Scottish Universities Research and Reactor Centre, Glasgow, UK). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

The Scottish Universities Research and Reactor Centre was established in 1963 to provide teaching, training and research facilities to all Scottish Universities. The Centre includes a 300 kW Argonaut type of research reactor. The jointly owned Centre has been highly successful, and other scientific disciplines have taken the opportunity to install research equipment for use by several universities. As a result the Centre has diversified its interests beyond the normal topics pursued by reactor establishments and now has very successful groups working in geochronology, stable isotope geochemistry, radiocarbon dating and nuclear medicine.

807 (IAEA-TECDOC—409, pp 215-225) **Incorporating the operation of a small research reactor facility to support a national nuclear power program.** Levine, S.H.; Kenney, E.S. (Pennsylvania State Univ., University Park, USA). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

A small research reactor similar to the Penn State Breazeale Nuclear Reactor, which is a 1 Megawatt TRIGA, can be invaluable in supporting a national nuclear power programme. The research reactor provides an operating reactor for training nuclear engineers, nuclear operators, and other nuclear specialists required to construct, operate, and maintain the nuclear power plant. When operation of the power plant begins, highly trained, well-qualified and competent personnel will be available to operate, supervise, and maintain a safe and efficient power plant operation. The paper describes the organization of a nuclear science centre as well as research reactor activities. An example of an actual two week training programme of an electric utility is included with a list of experiments and demonstrations. University projects and experiments using the reactor are listed. 8 refs, 8 figs.

808 (IAEA-TECDOC—409, pp 237-249) **Uses of small research reactors.** Rauch, H.; Badurek, G.; Grass, F. (Atominstitut der Oesterreichischen Universitaeten, Vienna). Mar 1987. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88700114/JAW. (CONF-8512139—; CONF-850932—).

From Technical committee meeting on research reactor activities in support of national nuclear programmes; Budapest, Hungary (10 Dec 1985).

The characteristic features of a small research reactor for university based research are described. The flexibility of the instruments and the rather low radiation level make it a useful tool for training, education, for test measurements and as a domestic base for cooperation with high flux facilities. The existence of various supporting laboratories is an essential requirement for a fruitful use. The research done during the last two decades at our 250 kW TRIGA reactor is reviewed shortly. The constraints of a low neutron flux have stimulated the development of new experimental techniques in the field of activation analysis, neutron optics, polarized neutron physics and small-angle scattering. 54 refs, 8 figs.

809 (INIS-BR—764) **Calculation of parameters for an iron shield experiment.** Gavazza, S. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). 1986. 135p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703512/JAW.

In this text is carreid out the evaluation of radiation transport methodology, comparying the calculated reactions and dose rates, for neutrons and gama-rays, with the experimental measurements obtained on iron shield, irradiated in YAYOI reactor. Were employed the ENDF/B-IV and VITAMIN-C libraries and the AMPX-II modular system for generation of cross sections, collapsed by the ANISN code. The tranpsort calculations were made by using the DOT 3.5 code, adjusting the spectrum of the iron shield boundary source to the reaction and doses rates, measured at the beginning of shield. The distributions calculated for neutrons and gamma-rays, on iron shield, presented reasonable concordance with the experimental measurements. Finally, is presented a proposal for setting up of an experimental arrangement, using the IEA-R1 reactor, with the purpose of lay down a shielding benchmark.

810 **(JAERI-M—87-063) Benchmark calculations on nuclear characteristics of JRR-4 HEU core by SRAC code system.** Arigane, Kenji. (Japan Atomic Energy Research Inst., Tokyo). Apr 1987. 138p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750048/JAW.

The reduced enrichment program for the JRR-4 has been progressing based on JAERI's RERTR (Reduced Enrichment Research and Test Reactor) program. The SRAC (JAERI Thermal Reactor Standard Code System for Reactor Design and Analysis) is used for the neutronic design of the JRR-4 LEU Core. This report describes the benchmark calculations on the neutronic characteristics of the JRR-4 HEU Core in order to validate the calculation method. The benchmark calculations were performed on the various kind of neutronic characteristics such as excess reactivity, criticality, control rod worth, thermal neutron flux distribution, void coefficient, temperature coefficient, mass coefficient, kinetic parameters and poisoning effect by Xe-135 build up. As the result, it was confirmed that these calculated values are in satisfactory agreement with the measured values. Therefore, the calculational method by the SRAC was validated.

811 **(Juel—2118) Heat-transfer analysis of the existing HEU and proposed LEU cores of Pakistan research reactor.** Khan, L.A.; Nabbi, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Forschungsreaktoren). Feb 1987. 70p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753285/JAW.

In connection with conversion of Pakistan Research Reactor (PARR) from the use of Highly Enriched Uranium (HEU) fuel to the use of Low Enriched Uranium (LEU) fuel, steady-state thermal hydraulic analysis of both existing HEU and proposed LEU cores has been carried out. Keeping in mind the possibility of power upgrading, the performance of proposed LEU core, under 10 MW operating conditions, has also been evaluated. Computer code HEATHYD has been used for this purpose. In order to verify the reliability of the code, IAEA benchmark 2 MW reactor was analyzed. The cooling parameters evaluated include: coolant velocity, critical velocity, pressure drop, temperature distribution in the core, heat fluxes at onset of nucleate boiling, flow instability and burnout and corresponding safety margins. From the results of the study it can be concluded that the conversion of the core to LEU fuel will result in higher safety margins, as compared to existing HEU core, mainly because the increased number of fuel plates in the proposed design will reduce the average heat flux significantly. Anyhow upgrading of the reactor power to 10 MW will need the flow rate to be adjusted between 850 to 900 m/sup 3//hr, to achieve reasonable safety margins, at least, comparable with the existing HEU core.

812 **(KURRI-TR—287) Measurement of neutron spectrum at irradiation facilities of Kyoto University Reactor, KUR.** Kobayashi, Katsuhei; Matsushita, Rokuji; Yoshida, Hiroyuki. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Jan 1987. 62p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750040/JAW.

By unfolding multi-foil activation data with NEUPAC code, neutron energy spectra at the irradiation facilities (hydraulic conveyoy tube, long irradiation plug, graphite thermal neutron column, low temperature loop and pneumatic tubes) of KUR have been obtained in the energy region from 0.01 eV to 16.4 MeV. Transport calculations by ANISN code have been also made, and agreed with the measured spectra, in general. By using the neutron spectra measured above, the spectrum-averaged cross section for the /sup 54/Fe(n,p)/sup 54/Mn reaction has been obtained as a basic datum to estimate the neutron fluence at the irradiation facilities. Neutron spectra at the low temperature loop and the pneumatic tubes have been also measured for the special core of KUR, whose fuel configuration was changed so that the exposure tube E-4 (low temperature loop) could directly see the fuel elements.

813 **(ORNL/TM—10505) Final report of the HFIR [High Flux Isotope Reactor] irradiation facilities improvement project.** Montgomery, B.H.; Thoms, K.R.; West, C.D. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 319p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88001446/JAW.

The High-Flux Isotope Reactor (HFIR) has outstanding neutronics characteristics for materials irradiation, but some relatively minor aspects of its mechanical design severely limited its usefulness for that purpose. In particular, though the flux trap region in the center of the annular fuel elements has a very high neutron flux, it had no provision for instrumentation access to irradiation capsules. The irradiation positions in the beryllium reflector outside the fuel elements also have a high flux; however, although instrumented, they were too small and too few to replace the facilities of a materials testing reactor. To address these drawbacks, the HFIR Irradiation Facilities Improvement Project consisted of modifications to the reactor vessel cover, internal structures, and reflector. Two instrumented facilities were provided in the flux trap region, and the number of materials irradiation positions in the removable beryllium (RB) was increased from four to eight, each with almost twice the available experimental space of the previous ones. The instrumented target facilities were completed in August 1986, and the RB facilities were completed in June 1987.

814 **(SURRC—75/87) [Scottish Universities Research and Reactor Centre, Glasgow] annual report 1985-1986.** Whitley, J.E. (Scottish Universities Research and Reactor Centre, Glasgow (UK)). 1987. 71p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87752958/JAW.

The paper is the annual report of the Scottish Universities Research and Reactor Centre, 1985-86. The contents include a description of the research activities, and the reactor and associated activities. The research activities include: environmental radioactivity, neutron activation analysis, clinical studies, gamma ray irradiation processing, radiation effects on insulation, radiogenic isotope geology, stable isotopes in geology and biological sciences, and radiocarbon studies. The reactor activities include: reactor operation, isotope production, and computing and counting systems.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 797, 804

815 **(DP-MS—87-54) Pu-238 production at the Savannah River Plant.** Roggenkamp, P.L. (Savannah River Lab., Aiken, SC (USA)). Nov 1987. Contract AC09-76SR00001. 26p. (CONF-871101—64-Vugraphs). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001373/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

Pu-238 production capability at SRP is dependent on the availability of Np-237 feed material. With continuing operation of three production reactors at SRP, production of 46 kg Pu-238 per year can be sustained. Capacity of auxiliary facilities is adequate to support the production rates.

816 **(JAERI-M—86-163) Design, fabrication and inspection of rabbit capsule.** Tsuyuzaki, Noriyoshi; Ichihashi, Yoshinori; Ooka, Kiichi; Tanaka, Isao. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703604/JAW.

Many capsules designed by Irradiation Div. 1 have been irradiated in the JMTR reactor in past years. The Irradiation Div. 1 has been developing and studying the irradiation and design techniques. This report contains the description of the design and inspection standard, fabrication and the basic design of small capsule called "Rabbit". Therefore, this report is very useful for proposer who want to irradiate small specimen by irradiation facility in the JMTR reactor.

817 **(JAERI-M—86-164) General description of irradiation and post irradiation examination in JMTR.** Tsuyuzaki, Noriyoshi; Sakai, Haruyuki; Ichihashi, Yoshinori. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 126p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703605/JAW.

The JMTR (Japan Materials Testing Reactor) was designed to provide suitable facilities for conducting nuclear irradiation experiments necessary for the research and development of power reactor in Japan. The JMTR consists of a 50 MW high flux reactor, irradiation facilities and a multi-cell hot laboratory. The available irradiation facilities are various kinds of capsules, hydraulic rabbit facilities, high temperature and high pressure water loop, and high temperature and high pressure gas loop. The aim of this publication is a representation of the information concerned with the irradiation facilities.

2208 Propulsion Reactors

818 **(CEA-CONF—8940) Status of CEA design and simulation studies of 200 KWe turboelectric space power system.** Carre, F.; Proust, E.; Gervaise, F.; Schwartz, J.P.; Tilliette, Z.; Vrillon, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Jan 1987. 6p. (CONF-870102—27). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752773/JAW.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

This paper presents the updated design features of the reference 200 kWe turboelectric space generator studied in France, and comments some of the alternative options to be analyzed in the near future, concerning the reactor and the conversion system in particular. Also presented the major conclusions of the simulation studies, that have been performed to analyze the overall behavior of the reference generator, during the start up and the accidental transients.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 351, 678, 696, 1743, 1747, 1751, 1943, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470

819 **(AAEC/E—643) Source term and behavioural parameters for a postulated HIFAR loss-of-coolant accident.** May, F.G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1987. 87p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700087/JAW.

The fraction of the fission product inventory which might be released into the atmosphere of the HIFAR reactor containment building (RCB) during a postulated loss-of-coolant accident (LOCA) has been evaluated as a function of time, for each classification of airborne radioactivity. This appraisal will be used as the source term for a computer program, which uses realistic attenuation of the fission product aerosol in a single compartment model with a defined leakrate to predict possible radioactive releases into the environment in a hypothetical bounding case reactor accident which is rather more severe in all major aspects than any single LOCA. Also given are the parameters governing the attenuation of the aerosol and vapours in the atmosphere of the RCB so that their behaviour may be accurately modelled. The source terms for several other types of accident involving the meltdown of fuel elements have also been considered but in less detail than the LOCA case. In some of the cases, the fission products are released directly to atmosphere, so there is no attenuation of the release by deposition within the RCB.

820 **(CEGB-TPRD/B—0823/R86) Initial assessment of the Chernobyl-4 reactor accident release source.** Macdonald, H.F.; Apsimon, H.M.; Wilson, J.J.N. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752842/JAW.

The long-range atmospheric dispersion model MESOS has been used to provide a preliminary evaluation of the effects over Western Europe of radioactivity released during the accident which occurred at the Chernobyl-4 reactor in the USSR in April 1986. The results of this analysis have been compared with observations during the first week or so following the accident of airborne contamination levels at a range of locations across Europe in order to obtain an estimate of accident release source. The work presented here was performed during the 6-8 weeks following the accident and the results obtained will be subject to refinement as more detailed data become available. However, at this early stage they indicate a release source for the Chernobyl accident, expressed as a fraction of the estimated reactor core inventory, of approx. 15-20% of the iodine and caesium isotopes, approx. 1% of the ruthenium and lesser amounts of the other fission products and actinides, together with an implied major fraction of the krypton and xenon noble gases.

821 **(CNEN-DR—134/86-1/2) Chernobylsk accident (Causes and Consequences). Part 1.** Esteves, D. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Jul 1986. 42p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703678/JAW.

Facts, project data, hypothesis, calculations, evaluations, monitoring, standard requirements and several considerations, related to causes, effects and consequences of Chernobylsk-4 accident. (M.C.K.).

822 **(CNEN-DR—134/86-2/2) Chernobylsk accident (Causes and Consequences). Part 2.** Esteves, D. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Sep 1986. 69p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703679/JAW.

The causes and consequences of the nuclear accident at Chernobylsk-4 reactor are shortly described. The informations were provided by Russian during the specialist meeting, carried out at seat of IAEA. The Russian nuclear panorama; the site, nuclear power plant characteristics and sequence of events; the immediate measurements after accident; monitoring/radioactive releases; environmental contamination and ecological consequences; measurements of emergency; recommendations to increase the nuclear safety; and recommendations of work groups, are presented. (M.C.K.).

823 **(CONF-870832—4) An expert system for alarm diagnosis and filtering.** Robinson, J.T.; Otaduy, P.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02. Order Number DE87014419/JAW.

From Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry; Snowbird, UT, USA (31 Aug 1987).

This paper describes an alarm processing system being developed at the Oak Ridge National Laboratory for implementation in the High Flux Isotope Reactor. The purpose of the system is to perform two related functions, alarm diagnosis and filtering, to aid nuclear plant operators in responding to the large number of alarms typically activated during a major plant transient. The alarm diagnostician determines the root cause of a pattern or sequence of alarms and generates an explanation of the events leading to the alarm sequence. The alarm filter identifies and deemphasizes those alarms which are either irrelevant to the current plant condition or contribute no significant new information. 2 refs., 5 figs.

824 **(EGG-M—01086) Comparison of oxide- and metal-core behavior during CRBRP [Clinch River Breeder Reactor Plant] station blackout.** Polkinghorne, S.T.; Atkinson, S.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 12p. (CONF-860906—28). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001601/JAW.

From Advances in reactor physics and safety meeting; Saratoga Springs, NY, USA (17 Sep 1986).

A resurrected concept that could significantly improve the inherently safe response of Liquid-Metal cooled Reactors (LMRs) during severe undercooling transients is the use of metallic fuel. Analytical studies have been reported on for the transient behavior of metal-fuel cores in innovative, inherently safe LMR designs. This paper reports on an analysis done, instead, for the Clinch River Breeder Reactor Plant (CRBRP) design with the only innovative

change being the incorporation of a metal-fuel core. The SSC-L code was used to simulate a protected station blackout accident in the CRBRP with a 943 MWt Integral Fast Reactor (IFR) metal-fuel core. The results, compared with those for the oxide-fueled CRBRP, show that the margin to boiling is greater for the IFR core. However, the cooldown transient is more severe due to the faster thermal response time of metallic fuel. Some additional calculations to assess possible LMR design improvements (reduced primary system pressure losses, extended flow coastdown) are also discussed. 8 refs., 13 figs., 2 tabs.

825 **(EGG-M—06686) Effectiveness and safety aspects of selected decontamination methods for LWR [light water reactor] maintenance support: Utilities' experiences.** Duce, S.W.; Case, J.T. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 13p. (CONF-860311—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001590/JAW.

From Nuclear power plant maintenance meeting; Salt Lake City, UT, USA (23 Mar 1986).

Use of chemical reagent processes to remove oxide films in primary coolant system piping has been widely performed in US light water reactors in 1984 and 1985. The principle application of chemical decontamination was in boiling water reactor (BWR) primary coolant and cleanup systems and in pressurized water reactor (PWR) steam generators, both primary and secondary sides. These chemical decontaminations were performed prior to inservice inspections or system repair to reduce the man-rem that would be received by the work force to perform the specified task(s). This paper presents information and results on (1) methods used for determining decontamination factors (DFs), (2) actual DFs obtained with chemical decontamination methods, (3) waste forms and volumes generated, (4) resultant man-rem savings and (5) lessons learned.

826 **(EGG-M—22386) Integrated SCDAP/RELAP5 analysis of a BWR [boiling water reactor] high pressure boiloff.** Chambers, R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 11p. (CONF-8610135—63). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001502/JAW.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A postulated high pressure boiloff in a boiling water reactor was analyzed using the SCDAP/RELAP5 computer code. Calculated damage to the core consisted of cladding failure, heavy oxidation, and relocation of molten core material. The slow cladding heatup rate allowed a thick zirconium dioxide shell to develop on the rod and channel surfaces, slowing oxidation and limiting relocation of core materials. The importance of multi-channel, integrated thermal-hydraulic and core behavior calculations was demonstrated by this boiloff simulation. The center of the core was heavily damaged, but the periphery remained intact. The cycling of the safety relief valves influenced zircaloy oxidation and hydrogen generation.

827 **(EGG-TMI—7789) Assessment of uncertainty in volume of prior molten zone based upon borehole video data: TMI [Three Mile Island]-2 reactor core.** Smith, R.P. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1987. Contract AC07-76ID01570. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001497/JAW.

Examinations of video tapes generated by a remote camera inserted into each of the 10 boreholes through the previously melted zone of the Three Mile Island-2 (TMI) reactor core have contributed greatly to our present knowledge of the end state configuration of damaged material in the core. In order to use the volumes of the damaged zones for fission product mass balance calculations, the uncertainty associated with calculations of those volumes must be known. This report documents the method used for evaluating the uncertainty.

828 **(EPRI-NP—5403) Modeling of molten corium-concrete interaction: Interim report.** Lee, M.; Kazimi, M.S. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 274p. Research Report Center, Box 50490, Palo Alto, Ca 94303. Order Number TI88920038/JAW.

In the highly unlikely event of a loss of cooling accident in a LWR followed by failure of certain engineered safety features of the reactor system, the core may eventually melt due to the generation of decay heat. If the safety features of the reactor system fail to arrest the accident within the vessel, the molten core debris (corium) will fall into the reactor cavity and attack the concrete walls and floor. The heat transferred from the core melt to concrete can lead to concrete decomposition accompanied by gas generation, which along with direct heating of the atmosphere will lead to a pressure rise in the containment. The cooling rate of the core melt and the amount of gas generated by concrete decomposition will also affect the degree to which fission products may be released from the melt. A semiempirical correlation for calculating the downward heat transfer coefficient is derived based on periodic contact between the liquid pool and the underlying solid. The experimental data on interfacial heat transfer between bubble agitated immiscible layers are reviewed and a new model is proposed. The proposed downward and interfacial heat transfer models have been incorporated into an integral analysis code, CORCON/Mod1, developed by Sandia Laboratories. A simplified containment model based on thermal equilibrium among all materials within the containment is developed, and is integrated with the modified CORCON/Mod1. The combined model, called CORCELL, is used to study the impact of Corium/Concrete Interaction on containment pressurization.

829 **(EPRI-NP—5430) Application of Reliability-Centered Maintenance to San Onofre Units 2 and 3 auxiliary feedwater systems: Final report.** Hook, T.G.; Hughes, E.A.; Levline, R.E.; Morgan, T.A.; Parker, L.M. (Erin Engineering and Research, Inc., Walnut Creek, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 181p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920041/JAW.

This report describes the third EPRI-sponsored application of Reliability-Centered Maintenance (RCM) to nuclear power plant systems. The goal of this study was to extend and enhance the proven RCM process through its application to a standby safety system and to incorporate, where practical, the use of fault tree models, reliability block diagrams, and quantitative importance measures to assist in the determination of the most critical portions of a given system. The study chosen for RCM application was the Auxiliary Feedwater System of San Onofre Units 2 and 3. The results of the study indicated that only a fraction of components in the system were responsible for the dominant system failure modes. The performance of these components during routine functional testing could be monitored and trended to help identify when extensive inspection and overhaul tasks should be performed. For those components which were shown to not have a significant failure mode, a reduction in the current PM program seems justified.

830 **(GRS-F—156) Reports on research programs in the field of reactor safety sponsored by the Federal Ministry for Research and Technology. Reported period: July 1 to December 31, 1986. Progress report.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). May 1987. 417p. (In German). NTIS (US Sales Only), PC A18/MF A01. Order Number DE87753297/JAW.

Investigations on the safety of light water reactors (LWR) being performed in the framework of the research program on reactor safety (RS-projects) are sponsored by the Federal Ministry for Research and Technology (BMFT). Objective of this program is to investigate in greater detail the safety margins of nuclear power plants and their systems and the further development of safety technology. Besides the investigations of LWR tasks also projects on the safety of advanced reactors are sponsored by the BMFT. The individual reports are classified according to the research program on the safety of LWRs 1977-1980 of the BMFT.

Another table of contents uses the same classification system as applied in the nuclear safety index of the CEC (Commission of the European Communities) and the OECD (Organization for Economic Cooperation and Development). The reports are arranged in the sequence of their project numbers.

831 (IAEA-TECDOC—424) **Identification of failure sequences sensitive to human error. Report of a technical committee meeting held in Vienna, 5-9 May 1986.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1987. 188p. (CONF-8605303—Summ.). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700184/JAW.

From Technical committee meeting on the identification of failure sequences sensitive to human error; Vienna, Austria (5 May 1986).

This report prepared by the participants of the technical committee meeting on Identification of Failure Sequences Sensitive to Human Error addresses the subjects discussed during the meeting and the conclusions reached by the committee. Chapter 1 reviews the INSAG recommendations and the main elements of the IAEA Programme in the area of human element. In Chapter 2 the role of human actions in nuclear power plants safety from insights of operational experience is reviewed. Chapter 3 is concerned with the relationship between probabilistic safety assessment and human performance associated with severe accident sequences. Chapter 4 addresses the role of simulators in view of training for accident conditions. Chapter 5 presents the conclusions and future trends. The seven papers presented by members of this technical committee are also included in this technical document. A separate abstract was prepared for each of these papers.

832 (IAEA-TECDOC—424, pp 95-102) **Results of German Risk Study and German Precursor Study in respect to human error.** Polke, H. (Gesellschaft fuer Reaktorsicherheit m.b.H., GRS, Garching, Germany, F.R.). Jun 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700184/JAW. (CONF-8605303—Summ.).

From Technical committee meeting on the identification of failure sequences sensitive to human error; Vienna, Austria (5 May 1986).

The paper reports the results of a survey of NPP operational experience conducted in the course of the analyses for the German Precursor Study (GPS), prepared by the Gesellschaft fuer Reaktorsicherheit by contract of the Federal Minister of Interior. The study aimed at getting a deeper understanding of the safety-related importance of events reported in reactor operation and on the identification of possible weak points including human interactions. Additionally, a limited comparison of the results for severe core damage frequency is performed with those of the German Risk Study (GRS). 4 references, 1 figure, 1 table.

833 (IAEA-TECDOC—424, pp 85-94) **Survey of human error contributions in some recent probabilistic risk assessments.** Bari, R.A. (Brookhaven National Lab., Upton, NY). Jun 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700184/JAW. (CONF-8605303—Summ.).

From Technical committee meeting on the identification of failure sequences sensitive to human error; Vienna, Austria (5 May 1986).

The human error contributions to the dominant accident sequences in some recent PRAs are surveyed. The plants considered are Millstone 3, Seabrook, Shoreham, and Oconee 3. The dominant accident sequences that contain human error contributions are displayed along with the per cent contribution to the total core damage frequency from each accident sequence and from the human error portion of each sequence. The survey shows that human error contributions appear in most of the dominant accident sequences for Shoreham, a BWR, but that only a few of the dominant accident sequences for the other plants, all PWRs, contain human error contributions. 1 reference, 13 tables.

834 (IAEA-TECDOC—424, pp 103-109) **Human error contributions to BWR accident sequences.** Adalioglu, U.; Goktepe, B.G. (Cekmece Nuclear Research and Training Center, Istanbul, Turkey). Jun 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700184/JAW. (CONF-8605303—Summ.).

From Technical committee meeting on the identification of failure sequences sensitive to human error; Vienna, Austria (5 May 1986).

Safety studies of industrial facilities have increasingly been the main concern of the public and the organizations which operates them. The conditions and needs specific to a certain country affects the safety policy and emergency planning. Developed countries, in general, concern for the emergency preparedness in case of an accident, whereas the prevention of catastrophic accidents would be the safety goal for a developing country since the economic burden of a facility lost is too heavy. The high rate of accidents caused by human negligence and maintenance faults in these countries is a well-known issue in non-nuclear fields. Bearing in mind these ideas five BWRs with different design and containment structure (i.e. Browns Ferry Unit 1, Millstone Point Unit 1, Grand Gulf Unit 1, Limerick Generating Station and Forsmark 3) have been chosen for reviewing with respect to dominant accident sequences, initiators, human errors, recovery etc. in order to gain some insight for the use of PRA technique in the interest of a developing country. The dominant accident sequences contributing to core melt frequency were identified and grouped according to the initiators and lost mitigating functions. Major human error types were shown for each reactor. The types of errors which have dominant contributions to core melt probability, in general, are found as manual depressurization of reactor system, and miscalibration of sensors. A general picture of current situation on accidents and human error contribution is given for Turkey. 7 references, 2 tables.

835 (IAEA-TECDOC—424, pp 135-147) **Development and applications of a methodology for the analysis of significant human related event trends in nuclear power plants.** Cho, H.Y.; Lee, S.H.; Park, I.Y. (Korea Advanced Energy Research Institute, Daeduk, Republic of Korea). Jun 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700184/JAW. (CONF-8605303—Summ.).

From Technical committee meeting on the identification of failure sequences sensitive to human error; Vienna, Austria (5 May 1986).

A methodology is developed to identify and flag significant trends related to the safety and availability of commercial nuclear power plants. The development is intended to aid in reducing likelihood of human errors. To assure that the methodology can be easily adapted to various types of classification schemes of operation data, a data bank classified by the Transient Analysis Classification and Evaluation (TRACE) scheme is selected for the methodology. The significance criteria for human-initiated events affecting the systems and for events caused by human deficiencies were developed. Clustering analysis was used to verify the learning trend in multidimensional histograms. A computer code is developed based on the K-means algorithm and applied to find the learning period in which error rates are monotonously decreasing with plant age. The Freeman-Tukey (F-T) deviates are used to select generic problems identified by a large positive value (here approximately over 2.0) for the deviate. The identified generic problems are: decision errors which are highly associated with reactor startup operations in the learning period of PWR plants (PWRs), response errors which are highly associated with Secondary Non-Nuclear Systems (SNS) in PWRs. Those are corresponding to inconsistencies in the pattern of associated data. The program P3F for the analysis of multiway frequency tables in Biomedical Computer Programs may provide incorrect estimates for the expected frequencies if structural zeros, where the frequency is constrained to be zero, occur. Therefore, to get reasonable results, efforts to eliminate structural zero entries in multiway tables should be made. This may be accomplished by redefining the multiway tables or by using a more general computer program for the multiway tables. 9 references, 4 figures, 4 tables.

836 (IAEA-TECDOC—424, pp 153-169) **Human failures and their investigation using training simulators.** Norros, L.; Pulkkinen, U.; Pyy, P.; Wahlstroem, B. (Valtion Teknillinen Tutkimuskeskus, Espoo, Finland). Jun 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700184/JAW. (CONF-8605303—Summ.).

From Technical committee meeting on the identification of failure sequences sensitive to human error; Vienna, Austria (5 May 1986).

At the Technical Research Centre of Finland we have been studying problems of process operation for some years. This research has, for the most part, been coordinated through the Nordic projects on design and operation of complex energy systems. For organizing and directing our own work we have found it necessary to try to define a comprehensive research plan or programme which we call Enhancing the mastery of work in process operation. In this approach human reliability has certainly been considered as one criteria of well mastered work but it has not been evaluated in probabilistic terms. Thus, our intention in this paper is, first, to present some of our empirical results of operating work and, then, briefly to discuss the use of such data for probabilistic risk analysis. 7 references, 3 tables.

837 (IAEA-TECDOC—424, pp 111-133) **Studies of severe transients in nuclear power plants by using the ENEA Engineering Simulator.** Mattucci, A.; Negrenti, E. (ENEA, Casaccia, Italy). Jun 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700184/JAW. (CONF-8605303—Summ.).

From Technical committee meeting on the identification of failure sequences sensitive to human error; Vienna, Austria (5 May 1986).

The improvement of the computer performances makes possible the development of more sophisticated models capable for instance to handle in real time a wide variety of accident conditions with an accuracy comparable with the one of the off-line codes. The idea to develop a new real time tool, the Engineering Simulator, has become attractive. In particular such a tool can be used for: test and verification of operational and emergency procedures; optimization of plant efficiency; design and verification of control systems; study of man-machine interface. In the paper, together with a brief description of the ENEA Engineering Simulator and the advanced models, the results of the selected transient are analyzed. The comparison has shown the adequacy of the Engineering Simulator to simulate severe transients in nuclear power plants. 3 references.

838 (IAEA-TECDOC—424, pp 149-152) **Identification of failure sequences sensitive to human errors in Hungarian nuclear power plants.** Bajsz, J. (Paksi Atomeroemue Vallalat, Hungary). Jun 1987. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700184/JAW. (CONF-8605303—Summ.).

From Technical committee meeting on the identification of failure sequences sensitive to human error; Vienna, Austria (5 May 1986).

Brief presentation of some of the most significant human errors with their consequences that have been detected at the Hungarian Nuclear Power Plant from March 1985. Systems and processes of NPP which are sensitive to human errors. PSA methods for discovery of factors which can involve severe accident sequences in case of human error. Lessons of human errors and feedback of experience for operator training.

839 (IFEU—29-ed.2) **Risk-orientated analysis of the SNR 300. Technical report 1. Risk assessment of the fast breeder reactor.** Kollert, R. (Institut fuer Energie- und Umweltforschung e.V., Heidelberg (Germany, F.R.)). Sep 1983. 204p. (In German). Institut fuer Energie- und Umweltforschung e.V., Heidelberg, Germany, F.R.

The study required by the West German Ministry of Research and Technology (RS 605) for the Committee on 'Future Nuclear Energy Policy' of the 9th German Parliament is concerned with the following main points: 1) Assessment of technical risks from the social aspect; 2) Discussion of terms and quantification of risks; 3) 'Engineering judgment' and 'questionable' methods in the Fast Breeder analysis of the Society for Reactor Safety (GRS); 4) Assessment criteria of potential damage.

840 (IKE—2-75) **Transient model to the thermal detonation.** Karachalios, K. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Apr 1987. 220p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE87753282/JAW.

The model calculates the escalation dynamics and the long time behavior of thermal detonation waves depending on the initial and boundary conditions (data of the premixture, ignition at a solid wall or at an open end, etc.). Especially, for a given mixture and a certain fragmentation behavior more than one stable steady-state cases resulted, depending on the applied ignition energy. Investigations showed a very good consistency between the transient model and a steady-state model which is based on the same physical description and includes an additional stability criterion. Also the influence of effects such as e.g. non-homogeneous coolant heating, spherical instead of plane wave propagation and inhomogeneities of the premixture on the development of the wave were investigated. Comparison calculations with large scale experiments showed that they can be well explained by means of the thermal detonation theory, especially considering the transient phase of the wave development.

841 (INIS-BR—734) **Chernobyl.** Leao, J.L.B. (Associacao Brasileira de Fisicos em Medicina, Rio de Janeiro). 1985. 7p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703486/JAW.

Brief comments about the accident in Chernobyl, are done. The calculation of radioactive dose discharged is presented. The radiologic aspects in Poland and Hungary is reported. (M.A.C.).

842 (INIS-mf—10708) **Chernobyl and the consequences. Documentation on a 'workshop on science' broadcast by SFB on June 23-28, 1986.** Raestrup, R.; Kundke, J. (Sender Freies Berlin (Germany, F.R.)). Jul 1986. 50p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753308/JAW.

SFB-Werkstatthefte.; No. 18.

The brochure contains the texts of a broadcasting series with the following subjects: 1) Brighter than a thousand suns - what happened at Chernobyl; 2) Radical assault on the genetic material - the effect of radiation; 3) It's the dose that counts - slight radiation and human health; 4) Nuclear fallout - contamination levels of water, soil and air; 5) Safety against bombing - how safe are German nuclear power plants; 6) Practical advice for consumers.

843 (INIS-mf—10711) **Response of structures to airpressure wave and induced ground wave caused by gas explosions. Pt. 1. Airpressure wave. Final report.** Knerr, G.; Stoecker, H. (Hochtief A.G. fuer Hoch- und Tiefbauten, Frankfurt am Main (Germany, F.R.). Abt. Kerntechnischer Ingenieurbau). Jun 1983. 443p. (In German). NTIS, PC E99; NTIS as TIB/B87-11501.

The dynamic response of a PWR-building is analysed for different load descriptions of a gas explosion. First the other parameters which influence the calculations are studied. Hence the mathematical model, the foundation condition and the structure are varied. The modifications of the foundation which change basic oscillations have significant influence. These are soil stiffness, embedment, higher damping and effective soil mass. Representing the soil as a continuum gives the same results if the first modes are represented correctly. The results from different loading conditions are compared with the BMI/IfBt standard. The given 'deflagration with varying concentration' leads to responses about 1/3 higher. The pressure oscillations are without influence. There is no frequency shift. Reflection is insignificant. The given 'detonation like deflagration' leads to 3-5 times the accelerations. The peaks are in the frequency range from 10 to 30 Hz. The reflection causes a significant part of the increase, and also causes a shift of frequencies. (HP/orig.).

844 **(INIS-mf—10712) Expertise of the Oeko-Institute on the application to obtain permission to partially dismantle the Niederaichbach nuclear power plant.** (Institut fuer Angewandte Oekologie e.V., Freiburg im Breisgau (Germany, F.R.); Institut fuer Angewandte Oekologie, Darmstadt (Germany, F.R.). Projektgruppe Reaktorsicherheit). Mar 1985. 99p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753292/JAW.

Werkstattreihe.; No. 17.

This expertise gives an overview on the problems associated with the decommissioning and dismantling of the Niederaichbach nuclear power plant, considering technical and legal aspects. It wants to prove that the dismantling of this reactor cannot serve as evidence to prove the general feasibility of reactor dismantling. Much space is dedicated to the discussion about where the borderline should be drawn between radioactive and non-radioactive materials according to the ordinance on radiation protection. The reasons for rejecting the partial dismantling application are given.

845 **(INIS-mf—10885) Collection of papers 1984.** (Vyzkumny Ustav Palivoenergetickeho Komplexu, Prague (Czechoslovakia)). 1985. vp. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87780124/JAW.

Separate abstracts have been prepared for individual papers from this collection.

846 **(INIS-mf—10979) Evaluation investigation 'Chernobyl'. Report on the action taken by the Dutch government on account of the nuclear reactor accident at Chernobyl, USSR.** Wall Bake, D.A. van den; Geut, L.; Zorn, G.W.H. (Berenschot B.V., Utrecht (Netherlands)). 22 Sep 1986. 95p. (In Dutch). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703567/JAW.

This report is an evaluation of the attitude of the Dutch government in response to the Chernobyl accident. It deals with measures taken by the government in order to minimize the (possible) effects, apparent shortcomings and how one has dealt with them, measures which can be taken at least by the Netherlands in case of a reactor accident given the presence of dozens of nuclear power plants in Europe. Good and less good aspects of the temporary organization are noted and some general recommendations are given. (Auth.). 15 refs.; 5 figs.

847 (INIS-mf—11001, pp 93-106) **Sensitivity evaluation of the live steam volumetric radioactivity detector at various isotopic compositions of WWER primary circuit.** Zhernov, V.S.; Matveev, V.V.; Pushkin, V.V.; Shermakov, A.E. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A detector is considered for continuous measuring of the live steam volumetric gamma radioactivity on the steam piping of the secondary circuit of NPP with WWER-440 and WWER-1000. The calculation of the detector sensitivity versus gamma-quanta energy is presented. On the basis of theoretical analysis a simple formula has been obtained relating the measuring device reading with the pipe and detector dimensions and accounting for the gamma-rays attenuation in steam and the pipe walls. Experimental data are presented. 3 refs.; 1 tab.; 10 figs.

848 (INIS-mf—11001, pp 3-16) **ARLOCA and BEBEL computation code systems for determining the radiation loads at the WWER site during accidents with coolant leakages.** Zeisler, P.; Moebert, K.; Toepfer, W.; Wenzel, G. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Mathematical models and computation code system are described for sequential calculations of radioactivity spreading during accidents, with analyzing some characteristic processes and barriers on the ways of radioactivity releases. Specialized codes are used for calculations of: fission products activity in the fuel element voids; fuel cladding temperature variations during accidents; number of damaged fuel elements under emergency conditions; amount of radioactivity released into atmosphere. The calculation results are discussed, the major source of errors during released activity calculation is identified as the uncertainty of the fuel element damage coefficient. 3 refs.; 1 tab.; 11 figs.

849 (INIS-mf—11001, pp 54-67) **Centralyzed radiation monitoring system for NPP with WWER based on radiation safety diagnostic instrumentation blocks.** Denisov, N.I.; Zhernov, V.S.; Zudkova, R.G.; Murashov, E.P.; Paryshev, V.Ya.; Pushkin, V.V.; Ryzhov, N.V.; Skatkin, V.M. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Recommendations and requirements are given to the lay-out of centralyzed systems of radiation monitoring based upon commercially produced blocks and devices of the radiation safety diagnostic instrumentation (RSDI). Some specific features of the centralyzed radiation monitoring systems for NPP with WWER are emphasized that should be taken into consideration in designing. Possible options of the system architecture with 100, 200, 300 monitoring channels per one NPP unit are shown as well as the lay-out of the devices for data presentation on different control boards of NPP. Measuring and testing procedures for separate blocks and devices of the system are described. 6 refs.; 2 tabs.; 7 figs.

850 (INIS-mf—11001, pp 188-191) **Development of an accidental neutron monitoring method with the use of track detectors.** Dajko, G.; Shomodi, D.; Medvetski, L. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

An accidental neutron monitoring equipment with the use of track detectors has been developed for hungarian NPP. In the dosemeter the plastic material of the detector acts as an emitter. The tracks have been revealed by means of electrochemical etching. The measuring results are presented that were used for the material and working concept choice, as well as the data needed for the dose rate evaluation including the calibration curves related to the reactor neutron spectrum. 5 figs.

851 (INIS-mf—11001, pp 218-221) **Approach to NPP personnel dose commitments planning.** Egorov, Yu.A.; Noskov, A.A.; Shamashov, A.F. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A method of dose commitments calculation and planning is suggested that allows to organize maintenance operations at a NPP with respect to the radiation conditions and amount of repair works so that the personnel dose commitments would not exceed the adopted or permissible limits. For calculations the following information is needed: distribution function of number of people versus dose; dose field configuration within the premises; time standards of carrying out the basic maintenance operations; locations of equipment that has to be inspected and repaired.

852 (INIS-mf—11001, pp 182-185) **Dose limiting in NPP radiation safety system.** Kunz, Eh.; Shevts, J. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Conditions and results of the ICRP radiation dose regulation system application in Czechoslovakia are discussed. Practical utilization of the protection optimization for the NPP radiation safety ensurance is demonstrated. Some measures intended for the dose regulation system introduction in Czechoslovakia are considered.

853 (INIS-mf—11001, pp 186-187) **Task of radiation hygiene inspection at NPPs.** Shevts, J.; Kunz, Eh. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The task and functions of the radiation-hygiene inspection in Czechoslovakia are presented. The radiation safety related information amounts that are to be presented to the hygiene inspection institutions are determined. The hygiene inspection content and forms at the stages of NPP designing, construction and operation are discussed. The hygiene inspection place is determined within the general radiation safety system.

854 **(INIS-mf—11001) Radiation safety of Nuclear Power Plants operation. Book 3. Collection of papers from CMEA scientific-engineering conference.** (Sovet Ehkonomicheskoj Vzaimopomoshchi, Moscow (USSR). Postoyannaya Komissiya po Ispol'zovaniyu Atomnoj Ehnergii v Mirnykh Tselyakh). 1983. 225p. (In Russian). (CONF-8205317—Pt.3). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW.

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Separate abstracts were prepared for the individual papers in this report. (JDB)

855 (INIS-mf—11002, pp 189-196) **Radiation safety at Bohunice NPP with WWER-440 reactor.** Feik, K.; Tsarakh, J. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

For the investigation of radiation conditions a stationary minitoring system has been used together with movable equipment. Film and thermoluminescent dosemeters were employed for gamma-field determination. The measuring results of corrosion and fission products activity in the primary circuit water are given compared with the calculated values as well as the dose rates in various plant premises with free, restricted and no access. Data on the activity of airborn releases through the ventilation stack and liquid wastes are presented. On the basis of the personnel monitoring data the annual collective dose equivalents have been calculated. For 88% of the personnel the dose equivalents do not exceed 0.1 mSv. The calculated maximum individual dose equivalent for the population is 4 order of magnitude lower than the maximum permissible one established by the sanitary regulations (5 mSv/a) and results in 0.02% addition to the natural background. 5 tabs.

856 **(INIS-mf—11002) Radiation safety of Nuclear Power Plants operation. Book 4. Collection of papers from CMEA scientific-engineering conference.** (Sovet Ehkonomicheskoj Vzaimopomoshchi, Moscow (USSR). Postoyannaya Komissiya po Ispol'zovaniyu Atomnoj Ehnergii v Mirnykh Tselyakh). 1984. 200p. (In Russian). (CONF-8205317—Pt.4). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW.

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Individual papers are included in the data bases. (PSB)

857 (JAERI-M—86-192, pp 29-36) **Assessment of the integrity of AGR core during an earthquake.** Smith, C.R. (National Nuclear Corp. Ltd., Risley, UK). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The seismic response of the core has been calculated using an idealisation having several hundred thousand degrees of freedom. The individual graphite bricks are idealised as rigid masses, whilst contact spring elements are used to represent the load transmissions or impacts that can take place between the bricks. The necessary input information for the contact spring elements (i.e. stiffness, damping and friction), has been obtained from test work. Whilst the dynamic response of the core itself is non-linear, the supporting steel structures are linearly elastic. Consequently, the dynamic characteristics of the supporting structures are evaluated with the non-linear core structure uncoupled, and are then used with the non-linear core model in a step-by-step explicit time history analysis. The paper discusses the analytical model and presents results from some of the predictions of core dynamic response to earthquakes. The development of criteria for graphite impacts, based on the J integral, is described. Impact tests on a range of brick slices have been used to give data on brick or key cracking under repeated impacts. Dynamic analysis of plane stress finite element models of these test geometries has been carried out in order to establish a qualified analysis method which can be used to extrapolate the test data to impact damage in the core. This analysis method is applied to finite element models of the core bricks in which the loadings due to operating conditions, environmental and ageing effects are included. In the presence of any existing state of stress at any time during the operating life, the damage due to repeated impacts defined by the time-history seismic response of the core may then be estimated through a cumulative damage procedure.

858 (JAERI-M—86-192, pp 113-119) **Experimental qualification of a mathematical model used to assess the AGR core seismic response.** Shaw, D.C. (National Nuclear Corp. Ltd., Risley, UK). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The seismic response of the graphite bricks contained in an Advanced Gas Cooled Reactor core has been determined analytically using a computer code, AGRCOR. The development of this code and the analysis techniques implemented within it are subjects of another paper. A test programme was undertaken to qualify AGRCOR and involved shaker table excitation of increasingly complex arrays of both sliced and full height bricks. The measured responses were then compared with those computed. Both single and multi-axis sinusoidal and earthquake excitation has been used. This paper describes the procedures used to test the more complex, full height brick arrays and discusses the correlation obtained between the measured and computed data. Generally, the agreement was found to be within the error bands calculated by combining all potential experimental and computational errors. Therefore the code was considered to be validated for these cases. In all other cases, the code results were found to be too high, hence conservative, by factors of up to x 4.

859 (JAERI-M—86-192, pp 120-127) **Seismic response analysis of prismatic block cores of the experimental VHTR.** Iyoku, T.; Motoki, Y.; Arai, T.; Miki, T.; Ide, A. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The core of the experimental VHTR consists of several hundreds prismatic fuel and reflector blocks arranged in the form of columns in a reactor pressure vessel. Of the array of 61 vertical columns, 30 columns contain fuel, and are arranged around seven in-core control rod columns. The active core array is surrounded by 12 replaceable reflector columns and 12 control rod columns. The prismatic blocks in each column are aligned in vertical direction with dowel and socket systems which allow rotation and vertical translation. The fuel blocks are of pin in block type. The permanent side reflector blocks form a composite cylindrical container. The core lateral restraint mechanism is located between the permanent side reflector and the reactor pressure vessel. One of the most important aspects in designing a block type core is to ensure the structural integrity of the core components and the safe shutdown of the reactor in the case of seismic excitation. In order to obtain the seismic response characteristics and aseismatic design data of the core, the experimental and analytical studies were carried out, using two-dimensional horizontal and vertical slice core models.

General asciamatic design requirement, core response analysis and the further improvement of dynamic analysis method and vibration test are reported. The computer code 'SONATING-2V' was used. The resonance frequency of the core ranges from 2 to 4 Hz. (Kako, I.).

860 **(JAERI-M—87-059) Analysis of space-time core dynamics on reactor accident at Chernobyl.** Takano, Makoto; Shindo, Ryuichi; Yamashita, Kiyonobu; Sawa, Kazuhiro. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 61p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750051/JAW.

Regarding reactor accident at Chernobyl in USSR, core dynamics has been analyzed by COMIC code which solves space-time dependent diffusion equation in three-dimension taking spatial thermohydraulic effect into account. The code was originally developed for high temperature gas-cooled reactors (HTGR), however, has been modified to include light water as coolant, instead of helium, for analysis of the accident. In the analysis, emphasis is placed on spatial effects on core dynamics. The analyses are performed for the cases of modeling the core fully and partially where 6 fuel channels surround one control rod channel. The result shows that the speed of applying void reactivity averaged over the core depends on the power and coolant flow distributions. Therefore, these distributions have potential to influence on the value and the time of peak power estimated by calculation.

861 **(JAERI-M—87-072) ROSA-III 100% break integral test Run 914. Break area parameter test.** Yonomoto, Taisuke; Tasaka, Kanji; Koizumi, Yasuo; Anoda, Yoshinari; Kumamaru, Hiroshige; Nakamura, Hideo; Suzuki, Mitsuhiro; Murata, Hideo. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 178p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750049/JAW.

This report presents the experimental data of RUN 914 conducted at the ROSA-III test facility. The facility is a volumetrically scaled (1/424) simulator for a BWR/6 with the electrically heated core, the break simulator and the scaled ECCS (emergency core cooling system). RUN 914 was a 100% split break test at the recirculation pump suction line with an assumption of HPCS diesel generator failure and conducted as one of the break area parameter tests. A peak cladding temperature (PCT) of 851 K was reached at 130 s after the break during the reflooding phase. Whole core was completely quenched by ECCS, and the effectiveness of ECCS was confirmed. The primary test results of RUN 914 are compared in this report with those of RUN 926, which was a 200 % double-ended break test. The initiation of core dryout in RUN 914 was almost the same as that in RUN 926. Duration of core dryourt was, however, longer in RUN 914 because of later actuation of ECCSs. PCT in RUN 914 was 67 K higher than that in RUN 926.

862 **(JAERI-M—87-074) Reactivity initiated accident analyses for the safety assessment of JRR-2 MEU core.** Kosuge, Ikuo; Ando, Hiroei; Koganezawa, Takashi; Uemura, Mutsumi. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 47p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750310/JAW.

JRR-2 is a 10 MW research reactor moderated and cooled with heavy water. The JRR-2 core is currently planed to be converted from highly-enriched uranium (HEU:93%) core to medium-enriched uranium (MEU:45 %) core. This report describes the analytical results of reactivity initiated accidents for the safety assessment of JRR-2 MEU Core. The following four cases have been selected for the assessment; (1) uncontrolled control rod withdrawal from zero power, (2) uncontrolled control rod withdrawal from full power, (3) removal of irradiation samples, (4) drop of primaly coolant temperature. Parameter studies have been made for each of the above cases. All analyses have been made by a computer code EUREKA-2. The results show that the safety criteria for JRR-2 MEU core are all met.

863 **(JAERI-M—87-090) Implementation of PWR steady state self-initialization feature into RELAP4/MOD6/U4/J3.** Yoshida, Kazuo. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 28p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750300/JAW.

A PWR steady state self-initialization feature has been implemented into the RELAP4/MOD6/U4/J3 code which is an improved version of RELAP4/MOD6 and can analyze not only large break but also small break LOCA in LWRs. This feature is originated from RELAP4/MOD7 which is the most updated released version of RELAP4 from INEL. Several FORTRAN subroutines in MOD7 related to this feature were transplanted into MOD6/U4/J3 with some improvements, which were the modification of method to take a balance of heat transfer between primary and secondary side at SG-U tubes, and to make it possible to nodalize secondary side of SG as multi-node. Advantages realized by implementation of this option are saving of time in initializaing a new model and an assurance of steady state and self consistency of input data in a small break LOCA analysis of a PWR.

864 **(KFK—4104) Physical and chemical behavior of LWR fuel elements up to very high temperatures.** Hagen, S.; Hofmann, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Jun 1987. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753317/JAW.

Chemical interactions between UO/sub 2/ fuel and Zircaloy cladding up to 2350degC are described. UO/sub 2//Zircaloy single effects tests have been performed with short LWR fuel rod segments in inert gas and under oxidizing conditions. The reaction kinetics of molten Zircaloy cladding with solid UO/sub 2/ fuel has been investigated with UO/sub 2/ crucibles containing molten Zircaloy. The UO/sub 2//Zircaloy reactions obey parabolic rate laws. The oxygen uptake by solid Zircaloy due to chemical interaction with UO/sub 2/ occurs nearly as quickly as that from the reaction with steam or oxygen. To study the competing effects of the external and internal cladding oxidation under realistic boundary conditions and the influence of the uncontrolled temperature escalation due to the exothermic steam/Zircaloy reaction on the maximum cladding temperature, single rod and bundle experiments have been performed. Electrically heated fuel rod simulators, including absorber rod material (Ag, In, Cd alloy for PWR or B/sub 4/C for BWR), guide tubes and grid spacers are used.

865 **(KFK—4197) Pattern recognition and prognostic methods in parametric signal models for early failure detection.** Scherer, K.P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Elektrotechnik). Jun 1987. 112p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753314/JAW.

For early failure detection in critical devices it is important to use intelligent signal processing methods in learning systems, so that a process evaluation can be optimized already on the signal processing level. On the one hand, pattern recognition methods are useful. On the other hand, about surveillance structures with parametric signal models there are a lot of questions not solved. In this report, a boiling detection system of real acoustic signals is demonstrated, how to survey such a physical process by methods of pattern recognition with enclosed parametric signal models. By introduction of prognostic models, a decision in form of a classification process can be made in advance. A surveillance is performed by the developed methods and the results are presented.

866 **(KFK—4256) SANDCMOT sodium boiling model.** Henkel, P.R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). May 1987. 70p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753295/JAW.

This report describes the sodium boiling model that recently was incorporated into SANDCMOT code. This code was previously used for clad motion analysis of unprotected loss of flow (ULOF) accidents in LMFBR's. The chosen boiling model is an unstructured flow model that uses three conservation equations (mass, momentum, enthalpy) for a mixture flow. Furthermore, thermodynamic equilibrium of the two phases is assumed along the saturation line. Mechanical disequilibrium, however, is allowed and described by a slip correlation. As SANDCMOT considers several subchannels that are connected radially, the boiling model is two dimensional (r,z geometry). A first step of verification work was done by recalculating the TREAT-R5 experiment.

867 **(KFK—4264) Release of fission and activation products during LWR core melting. Final report of the SASCHA program.** Albrecht, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Jun 1987. 104p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753315/JAW.

Out-of-pile experiments were carried out in the SASCHA facility to investigate fission product release and aerosol formation under LWR core melting conditions. Besides fuel temperature, chemical composition of the core melt and test atmosphere were considered as important parameters. The results include the following aspects: Behavior of iodine and cesium during and after release from the fuel; potential of AgI formation in the gas phase; size distribution and chemical composition of aerosol particles; influence of the degree of Zircaloy oxidation on the release; fractional release rate coefficients of 20 elements for 2400degC; release during melt/concrete interaction; estimates of integral values for the release of radioactivity, decay heat, and aerosol mass from a PWR primary system.

868 **(KURRI-TR—288) Records of radiation control division, No.22 (1985).** Fukui, Masami (ed.); Katsurayama, Kousuke; Ishida, Masahiro. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Mar 1987. 113p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750038/JAW.

This report is a summary of activities of the radiation control division on the safety management in FY 1985. This report describes the records of the radiation control based on the activities of Indoor Radiation Control Section, Field Radiation Control Section and Personnel Radiation Control Section. External radiation doses were monitored using survey meters and film badges in the working area. Radioactive concentrations in dust and air were monitored in the radiation controlled area and at a number of locations outside the KURRI facilities. Reports of routine tasks such as the meteorological records, and the control of human exposure to radiation are described. This report also summarizes number of unscheduled tasks performed, including the replacement of the centralized monitoring board for radiation control, radiation monitors related to the extension of the spent fuel storage building, and the computer processing system of some indoor radiation monitors. Measurements of environmental radioactivity at several field locations are also presented in this report.

869 (NEI-FI—1, pp 4.2.1-4.2.12) **Approximation errors during variance propagation.** Dinsmore, S. (Studsvik Energiteknik AB, Nykoeping Sweden). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Risk and reliability analyses are often performaed by constructing and quantifying large fault trees. The inputs to these models are component failure events whose probability of occurring are best represented as random variables. This paper examines the errors inherent in two approximation techniques used to calculate the top event's variance from the inputs' variance. Two sample fault trees are evaluated and several three dimensional plots illustrating the magnitude of the error over a wide range of input means and variances are given.

870 (NEI-FI—1, pp 6.3.1-6.3.13) **Phased mission reliability. A new approach based on event sequence modeling.** Mankamo, T. (Avaplan Oy, Espoo, Finland). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Process plant systems usually have several functions called on in different phases of the operation. The relative capacity and redundancy requirements of individual subsystems often change from one phase to another, and as a result, the system success/failure logic changes in the course of the total mission. In the conventional fault tree approach, the changing logic is described by complex definition of component failure events. This paper describes a new approach where the primary model is the event sequence structure. This approach has the advantage that not only the changing functional requirements are included and evaluated effectively but also the modeling and quantification of sequence specific decisions, possible restoration of failed equipment and other kind of sequential dependences, are greatly enhanced.

871 (NEI-FI—1, pp 7.1.1-7.1.15) **Probabilistic safety analysis and human errors.** Wahlstroem, B. (Technical Research Centre of Finland, Espoo, Finland. Electrical Engineering Lab.). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Probabilistic safety analysis (PSA) has been used as a tool for identifying potential safety threats mostly in nuclear power plant but also in process palnt operation. The construction of failure models and the use of failure data have for technical systems provided rather accurate predictions of observed failure rates. Actual accidents and disturbances have however shown that also human errors contribute to the risks of operation. The paper discusses on a general level some of the problems associated with the inclusion of human errors in a safety analysis. The construction of fault sequences involving human errors are not straightforward due to the very large spectrum of human actions possible. The quantification of different possibilities for human errors has also to rely on subjective judgement. In spite of such difficulties it seems however evident that some quantification has to be made in order to priorize between different improvements proposed in the system design, procedures or staff training.

872 (NEI-FI—1, pp 7.3.1-7.3.22) **Treatment of human errors in safety studies.** Waessman, P.O. (Swedish State Power Board, Stockholm). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

This paper describes how Swedish State Power Board is treating human errors in on going safety studies with some detailed examples which clarifies the methodology.

873 (NEI-FI—1, pp 7.4.1.-7.4.12) **Human reliability analysis in Loviisa probabilistic safety analysis.** Illman, L.; Isaksson, J.; Makkonen, L.; Vaurio, J.K.; Vuorio, U. (Imatran Voima Oy, Helsinki, Finland). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

The human reliability analysis in the Loviisa PSA project is carried out for three major groups of errors in human actions: (A) errors made before an initiating event, (B) errors that initiate a transient and (C) errors made during transients. Recovery possibilities are also included in each group. The methods used or planned for each group are described. A simplified THERP approach is used for group A, with emphasis on test and maintenance error recovery aspects and dependencies between redundancies. For group B, task analyses and human factors assessments are made for startup, shut-

down and operational transients, with emphasis on potential common cause initiators. For group C, both misdiagnosis and slow decision making are analyzed, as well as errors made in carrying out necessary or backup actions. New or advanced features of the methodology are described.

874 (NEI-FI—1, pp 8.1.1-8.1.12) **Advances in methods and applications of reliability and safety analysis.** Fieandt, J.; Hossi, H.; Laakso, K.; Lyytikaeinen, A.; Niemelae, I.; Pulkkinen, U.; Pulli, T. (Technical Research Centre of Finland, Espoo. Electrical Engineering Lab.). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

The know-how of the reliability and safety design and analysis techniques of VTT has been established over several years in analyzing the reliability in the Finnish nuclear power plants Loviisa and Olkiluoto. This experience has been later on applied and developed to be used in the process industry, conventional power industry, automation and electronics. VTT develops and transfers methods and tools for reliability and safety analysis to the private and public sectors. The technology transfer takes place in joint development projects with potential users. Several computer-aided methods, such as RELVEC for reliability modelling and analysis, have been developed. The tool developed are today used by major Finnish companies in the fields of automation, nuclear power, shipbuilding and electronics. Development of computer-aided and other methods needed in analysis of operating experience, reliability or safety is further going on in a number of research and development projects.

875 (NEI-FI—1, pp 8.4.1-8.4.12) **Some managements lessons from U.S. industry-sponsored nuclear PRAs.** Joksimovich, V.; Orvis, D.D. (NUS Corporation, San Diego, CA (USA)). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

This paper discusses briefly: (1) U.S. utility risk management programs including cost/benefit considerations, (2) some current licensing topics that are being resolved through a PRA process and (3) trend regarding human reliability estimates in PRA studies.

876 (NEI-FI—1, pp 8.5.1.-8.5.11) **Analysis of external events in nuclear power plants.** Gunsell, L. (Swedish State Power Board, Stockholm, Sweden). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

This paper gives an overview of ongoing analyses of external events at the Swedish State Power Board. The main object is to describe the method used in the analyses, important assumptions and the results. The events described are internal flood and fire. A scheme is formed to judge which other events that should be investigated.

877 (NEI-FI—1, pp 9.1.1-9.1.15) **Overview of seismic risk analysis methodology as applied to industry sponsored nuclear PRAs.** Lydell, B.O.Y.; Parry, G.W.; Ravindra, M.R. (NUS Corporation, San Diego, CA USA; NUS Corporation, Gaithersburg, MA USA; EQE Incorporated, Newport Beach, CA USA). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Experience from the performance of comprehensive probabilistic risk assessment (PRA) studies on nuclear power plants in the USA indicates that the contributions to severe core damage and risk from external events such as earthquakes can be substantial. The purpose of this paper is to give an overview of the seismic PRA methodology, explain the differences between the internal events PRA and the seismic PRA, and finally to discuss the insights gained from the performance and review of a number of seismic PRAs. Based on these insights, the performance of a seismic PRA in order to locate possible weak links in systems and plant design and to address ways of enhancing plant safety, can be justified.

878 (NEI-FI—1, pp 9.3.1-9.3.12) **Comparison of methods for estimating beta-binomial failure probabilities.** Vaurio, J.K.; Jaenkaelae, K. (Imatran Voima Oy, Helsinki, Finland). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

An effective method is developed for estimating failure rates and unavailabilities for plant-specific risk studies from scarce data. A new technique is used for determining empirical prior distributions first, and individual component estimates are then determined as posterior distributions. This parametric robust empirical Bayes (PREB) method uses conjugate prior distributions, in this case beta priors for binomial observations. The method has been applied to nuclear plant reliability data and compared to other methods with a variety of numerical data. The results demonstrate the superiority of the PREB method over alternative techniques, especially for small samples. Connection to Stein's and fiducial estimation are discussed, bridging a gap between Bayesian and frequentist estimation.

879 (NEI-FI—1, pp 9.4.1-9.4.12) **Fire risk analysis: status of computer codes for simulation of compartment fires.** Hallberg, T.; Hirschberg, S.; Pedersen, M.; Tannenberg, D.; Aakerlund, O. (ASEA-ATOM AB, Vaesteraas, Sweden; Studsvik Energiteknik AB, Nykoeping, Sweden). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Three computer codes for simulation of compartment fires (BRAND, COMPBRN, DSLAY 1), all using a two-zone model, are available in Sweden. Typical information generated by these codes comprises temperatures and heat fluxes during a fire. Thus, basis is provided for estimation of failure times of objects (e.g. cables) and for indicating the potential for flashover in the compartment. The results are subject to rather large uncertainties. Although all the codes mentioned above use the relatively simple two-zone model, there are still significant differences in the modeling details, capacities of the programs, and in assumptions made. The qualitative features of the models have been compared and evaluated. In addition, several case studies have been performed, independently as well as in form of benchmark-type analyses. The findings of these comparative analyses will be presented, with main emphasis on the needs specified by the fire risk analyses currently in progress.

880 (NEI-FI—1, pp 9.6.1-9.6.13) **Hierarchical procedure for calculation of risk importance measures.** Poern, K.; Dinsmore, S. (Studsvik Energiteknik AB, Nykoeping, Sweden). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Starting with a general importance definition based on conditional probabilities, a hierarchical process for calculating such measures from a PRA's numerical results is developed. By the appropriate choice of events in the general definition, measures such as the risk achievement worth and the risk reduction worth can be calculated without requantifying the PRA models. Required approximations are clearly defined and the subsequent constraints on the applicability of the process discussed.

881 (NEI-FI—1, pp 9.10.1-9.10.6) **Method for coding and documentation of reliability block-diagram.** Vanhala, J. (Tapiola Insurance Group, Espoo, Finland). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Reliability block-diagram is a widely used method in risk, availability and reliability analysis. In comparison with the faulttree method it offers many advantages, e.g. better functional analogy with the analyzed process. This analogy, however, easily disappears if the amount of details to be modelled is large. This paper describes a method, developed during the PRA of TVO 1, which makes it possible to create reliability block-diagrams in a hierarchial way without losing any essential information.

882 (NEI-FI—1, pp 10.4.1-10.4.6) **Accident at the Chernobyl Nuclear Power Plant.** Laaksonen, J. (Finnish Centre for Radiation and nuclear power plant). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

In this paper the technical background of the Chernobyl accident and the events which led to the reactor explosion are discussed. Also some implications on the safety of LWR plants are presented.

883 (NEI-FI—1, pp 11.4.1-11.4.14) **Comments on uncertainties and limitations of systematic risk analysis.** Pulkkinen, U. (Technical Research Centre of Finland, Espoo Finland. Electrical Engineering Lab.). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

This paper describes the nature of the incompletenesses, uncertainties and limitations connected in the different phases of systematic risk and safety assessments. The possibilities and needs to evaluate the uncertainties are also discussed. The uncertainties of quantitative risk and safety assessment are mainly connected with the modelling and identification phases of the whole study. The uncertainties connected in quantification originate mainly from the poor or sparse reliability data and they can be handled principle by using statistical methods. The incompletenesses of modelling and identification are caused by the complexity of the systems and it may be impossible to evaluate their impact on the results on the reliability of the analysis. The problem to use incomplete or more or less uncertain results of risk analyses in decision making is discussed in this paper. The problem is identified to be similar to weighting of different factors in multiobjective optimisation. Finally some conclusions concerning the needs and possibilities of systematic risk analyses are discussed.

884 (NEI-FI—1, pp 12.1.1-12.1.12) **Common cause failures: identification and quantification.** Hirschberg, S.; Bengtz, M.; Dinsmore, S.C.; Petersen, K.E.; Pulkkinen, U. (ASEA-ATOM AB, Vaesteraas Sweden; Studsvik Energiteknik Ab, Nykoeping Sweden; Risoe National Lab., Roskilde Denmark; Valtion Teknillinen Tutkimuskeskus, Espoo, Finland). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

In the context of Probabilistic Safety Analysis (PSA), treatment of Common Cause Failures (CCFs) may have critical influence on the credibility of the studies, on the question of completeness and on interpretation of results. A nordic project 'Risk analysis', initiated in 1985, has among its main objectives to perform in-depth studies of dependent failures and human interactions, and generally to investigate assumptions and limitations of current PSAs. During the first phase of the project the activities concentrated on performing a Benchmark Exercise (BE) concerning CCF-data. Preliminary results of the exercise are presented in this report. The main findings concern both procedures for search for CCFs, use of classification systems, and quantification of CCF-contributions by means of direct assessment and use of parametric models.

885 (NEI-FI—1, pp 13.1.1-13.1.8) **Probabilistic safety analyses in the licensing and regulation of Finnish nuclear power plants.** Virolainen, R. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

A guide on the use of PSA in the licensing and regulation of NPPs has been prepared by the Finnish Centre for Radiation and Nuclear Safety (STUK). The guide is intended to be used in connection with new plants, excluding the back-fitting procedure presented at the end of the guide that is also applied to operating plants. In the licensing and regulation of new nuclear plants one applies both the deterministic and the probabilistic approach, which supplement each other. The results of both approaches are compared in the final safety evaluation. Subsequently the weaknesses of the plants and the actions needed to eliminate them are prioritized. A probabilistic safety analysis is connected to the licensing starting from the preliminary planning, and the extent of the risk analyses is planned to suit each design and construction phase.

886 (NEI-FI—1, pp 13.2.1-13.2.9) **Evaluation of release mitigating measures in severe reactor accidents.** Gunsell, L. (Swedish State Power Board, Stockholm, Sweden). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

In this paper some remarks have been put down on a resent use of risk analyses to evaluate the need for installing containment filtered vent or other release mitigating system in nuclear power plants in Sweden. It includes the background for doing the analyses, the method and assumptions used, optional system to be analysed and the result in the form of risk curves.

887 (NEI-FI—1, pp 13.3.1-13.3.12) **Continued plant operation versus shutdown in failure situations.** Kosonen, M.; Saarenpaeae, T.; Vanhala, J.; Mankamo, T. (Industrial Power Company Ltd., Helsinki, Finland; Avaplan Oy, Espoo, Finland). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

This paper describes the results of the latest study made at the TVO power plant for the evaluation and balancing of Technical Specifications by means of probabilistic methods. The recent application of the methods developed is concerned with the residual heat removal systems. The repair times allowed during plant operation by the Technical Specifications were examined by comparing the risk of plant shutdown with continued operation, given specific failure combinations in the relevant systems. The results so far seem to justify the reconsideration of shutdown requirements in case of failures in the residual heat removal systems.

888 (NEI-FI—1, pp 13.4.1-13.4.12) **Optimisation of technical specifications using probabilistic methods.** Ericsson, G.; Knochenhauer, M.; Hultqvist, G. (ASEA-ATOM AB, Vaesteraas, Sweden; Swedish State Power Board, Stockholm, Sweden). Oct 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW. (CONF-8610305—).

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

During the last few years the development of methods for modifying and optimising nuclear power plant Technical Specifications (TS) for plant operations has received increased attention. Probalistic methods in general, and the plant and system models of probabilistic safety assessment (PSA) in particular, seem to provide the most forceful tools for optimisation. This paper first gives some general comments on optimisation, identifying important parameters and then gives a description of recent Swedish experiences from the use of nuclear power plant PSA models and results for TS optimisation.

889 **(NEI-FI—1) SRE symposium '86.** (Society of Reliability Engineers, Vaesteraas (Sweden). Scandinavian Chapter; Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Oct 1986. 664p. (CONF-8610305—). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780013/JAW.

From SRE symposium; Otaniemi, Finland (14 Oct 1986).

Separate abstracts were prepared for the individual papers in this report. (JDB)

890 **(NOR—4124) Nuclear decommissioning.** Lawton, H. (UKAEA Windscale Nuclear Power Development Labs.). Jan 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752840/JAW.

Sufficient work has now been done, on a world-wide basis, to justify confidence that full decommissioning of nuclear installations, both plant and reactors, can be carried out safely and efficiently. Projects in several countries should confirm this in the next few years. In the United Kingdom, good progress has been made with the Windscale Advanced Gas-cooled Reactor and supporting

development work is finding solutions to resolve uncertainties. Estimates from several sources suggest that decommissioning costs can be kept to an acceptable level.

891 (NRPB-R—207) Doses in radiation accidents investigated by chromosome aberration analysis. XVII: a review of cases investigated, 1986. Lloyd, D.C.; Edwards, A.A.; Prosser, J.S.; Moquet, J.E.; Finnon, P. (National Radiological Protection Board, Chilton (UK)). Mar 1987. 11p. H.M. Stationery Office, London, price Pound3.00.

During 1986, 22 cases of suspected overexposure to ionising radiation were referred to the National Radiological Protection Board for investigation by cytogenetic analysis. The results are presented in this report. Of the 22 cases, 11 were associated with industrial radiography, four were from major nuclear organisations and the remaining seven were from institutions of research, education or health. No biological indication of overexposure was found for 18 cases. Of the remaining four, two involved small doses received by a dentist and assistant from their X-ray set. Another concerned a reactor worker probably exposed to about 40 mSv of fast neutrons. The most serious incident was one in which chromosomal analysis is of limited relevance. In this incident, a worker sustained burns from a 130 TBq (3400 Ci) gamma source, but the exposure was mainly confined to the hands.

892 (NUREG—0825-Suppl.1) Integrated Plant Safety Assessment, Systematic Evaluation Program: Yankee Nuclear Power Station (Docket No. 50-29). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Oct 1987. 32p. NTIS, PC A03/MF A01 - GPO. Order Number DE88900070/JAW.

The US Nuclear Regulatory Commission (NRC) has prepared Supplement 1 to the final Integrated Plant Safety Assessment Report (IPSAR) (NUREG-0825), under the scope of the Systematic Evaluation Program (SEP), for Yankee Atomic Electric Company's Yankee Nuclear Power Station located in Rowe, Massachusetts. The SEP was initiated by the NRC to review the design of older operating nuclear power plants to reconfirm and document their safety. This report documents the review completed under the SEP for those issues that required refined engineering evaluations or the continuation of ongoing evaluations after the Final IPSAR for the Yankee plant was issued. The review has provided for (1) an assessment of the significance of differences between current technical positions on selected safety issues and those that existed when Yankee was licensed, (2) a basis for deciding how these differences should be resolved in an integrated plant review, and (3) a documented evaluation of plant safety. 2 tabs.

893 (NUREG—1144-Rev.1) Nuclear Plant Aging Research (NPAR) program plan: Components, systems, and structures. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Sep 1987. 135p. NTIS, PC A07/MF A01 - GPO. Order Number DE88900090/JAW.

The nuclear plant aging research described in this plan is intended to resolve issues related to the aging and service wear of equipment and systems and major components at commercial reactor facilities and their possible impact on plant safety. Emphasis has been placed on identification and characterization of the mechanisms of material and component degradation during service and evaluation of methods of inspection, surveillance, condition monitoring, and maintenance as means of mitigating such effects. Specifically, the goals of the program are as follows: (1) to identify and characterize aging and service wear effects which, if unchecked, could cause degradation of equipment, a systems, and major components and thereby impair plant safety; (2) to identify methods of inspection, surveillance, and monitoring, or of evaluating residual life of equipment, systems, and major components, which will ensure timely detection of significant aging effects prior to loss of safety function; and (3) to evaluate the effectiveness of storage, maintenance, repair, and replacement practices in mitigating the rate and extent of degradation caused by aging and service wear.

894 (NUREG—1266-Vol.1) NRC safety research in support of regulation, 1986. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Sep 1987. 62p. NTIS, PC A04/MF A01 - GPO. Order Number DE88900027/JAW.

This report is the second in a series of annual reports responding to congressional inquiries as to the utilization of nuclear regulatory research. NUREG-1175, "NRC Safety Research in Support of Regulation," published in May 1986, reported major research accomplishments between about FY 1980 and FY 1985. This report narrates the accomplishments of FY 1986 and does not restate earlier accomplishments. Earlier research results are mentioned in the context of current results in the interest of continuity. Both the direct contributions to scientific and technical knowledge and their regulatory applications, when there has been a definite regulatory outcome during FY 1986, have been described.

895 (NUREG—1286) Safety Evaluation Report related to the restart of Rancho Seco Nuclear Generating Station, Unit 1, following the event of December 26, 1985 (Docket No. 50-312). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Oct 1987. 197p. NTIS, PC A09/MF A01 - GPO. Order Number DE88900106/JAW.

On December 26, 1985, the Rancho Seco Nuclear Generating Station, owned and operated by the Sacramento Municipal Utility District (SMUD), experienced a loss of dc power within the integrated control system (ICS) while the plant was at 76% power. The ensuing reactor trip was followed by a rapid overcooling transient and automatic initiation of the safety features actuation system (SFAS). The overcooling transient continued until ICS dc power was restored 26 minutes after its loss. Two letters from the NRC Region V Administrator (dated December 26, 1985) confirmed that the Rancho Seco plant would not be returned to power operation until SMUD (the licensee) had provided the NRC with an assessment of the root cause of the transient and a justification as to why the Rancho Seco facility is ready to resume power operation. In response, the licensee submitted the "Rancho Seco Action Plan for Performance Improvement" on July 3, 1986; revisions to that action plan were submitted on December 15, 1986 and February 28, 1987. The NRC staff has reviewed the action plan and numerous other supporting documents submitted by the licensee. The staff's evaluation of the information supporting restart of Rancho Seco is presented in this safety evaluation report.

896 (NUREG/CP—0090) Transactions of the fifteenth water reactor safety information meeting. Weiss, A.J. (comp.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Oct 1987. 269p. NTIS, PC A12/MF A01 - GPO. Order Number DE88900097/JAW.

This report contains summaries of paper on reactor safety research to be presented at the 15th Water Reactor Safety Information Meeting held at the National Bureau of Standards in Gaithersburg, Maryland, October 26-29, 1987. The summaries briefly describe the programs and results of nuclear safety research sponsored by the Office of Nuclear Regulatory Research, USNRC. Summaries of invited papers concerning nuclear safety issues are included from the Office of Nuclear Reactor Regulation, USNRC, in addition to summaries of invited papers that cover the highlights of reactor safety research conducted by the Department of Energy (DOE), the electric utilities through the Electric Power Research Institute (EPRI), the nuclear industry, and the research of government and industry in Europe and Japan. The summaries have been compiled in one report to provide a basis for meaningful discussion and information exchange during the course of the meeting, and are given in the order of their presentation in each session.

897 (NUREG/CR—2000-Vol.6-No.8) **Licensee event report (LER) compilation: For month of August 1987.** (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Sep 1987. Contract AC05-84OR21400. 118p. (ORNL/NSIC—200-Vol.6-No.8). NTIS, PC A06/MF A01 - GPO. Order Number DE88000544/JAW.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System - Description of Systems and Guidelines for Reporting, provides supporing guidance and information on the revised LER rule.

898 (NUREG/CR—4715) **An aging assessment of relays and circuit breakers and system interactions.** Toman, G.J.; Bacanskas, V.P.; Shook, T.A.; Ladlow, C.C. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Jun 1987. Contract AC02-76CH00016. 181p. (BNL-NUREG—52017). NTIS, PC A09/MF A01 - GPO. Order Number DE88000884/JAW.

This report provides an assessment of the aging of circuit breakers and relays which are vital components of the nuclear power plant electrical safety system, and was conducted under the auspices of the NRC Nuclear Aging Research (NPAR) Program. The study included protective, control, and logic relays, and molded-case and metal-clad switchgear circuit breakers. The relay failures were attributable to coil deterioration, changes in dimensions of critical organic components, and changes in characteristics of timing diaphragms from thermal deterioriation. Some of the failure modes will prevent fail-safe operation. The electrical control and mechanical portions of metal-clad switchgear were found to be more failure prone than the main contacts and arc extinguishing systems. Circuit breakers and relays in a PWR safety injection system were evaluated with respect to the aging induced by system operation. The effect of circuit breaker and relay deterioration on the ability of the system to perform its safety functions was also evaluated.

899 (NUREG/CR—4722) **Source term estimation using MENU-TACT.** Sjoreen, A.; McKenna, T.; Julius, J. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 63p. (ORNL—6314). NTIS, PC A04. Order Number TI87003636/JAW.

MENU-TACT is a computer code designed to be used for source term estimation during reactor emergencies. The code allows the user to define initial concentrations of the nuclides in the reactor and the release pathway and timing. Filtering and other in-plant removal processes may be included. MENU-TACT, a modification of the TACT-III code, is simple to use. To provide quick results of bounding calculations, it incorporates only those processes that can make major changes in reactor releases. 7 refs., 5 figs., 10 tabs.

900 (NUREG/CR—4799) **RELAP5/MOD2 assessment simulation of semiscale MOD-2C test S-NH-3.** Megahed, M.M. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems). Oct 1987. Contract AC07-76ID01570. 51p. (EGG—2519). NTIS, PC A04/MF A01 - GPO. Order Number DE88001568/JAW.

This report documents an evaluation of the RELAP5/MOD2/Cycle 36.05 thermal hydraulic computer code for a simulation of a small-break loss-of-coolant accident transient (SBLOCA). The experimental data base for the evaluation is the results of Test S-NH-3 performed in the Semiscale MOD-2C test facility. The test modeled a 0.5% SBLOCA with an accompanying failure of the high-pressure injection emergency core cooling system. The test facility and RELAP5/MOD2 model used in the calculations are described. Evaluations of the accuracy of the calculations are presented in the form of comparisons of measured and calculated histories of selected parameters associated with the primary and secondary systems. A conclusion was reached that the code is capable of making SBLOCA calculations efficiently. However, some of the SBLOCA-related phenomena were not properly predicted by the code, suggesting a need for code improvement.

901 (NUREG/CR—4903-Vol.1, pp A.1-A.20) **Attenuation of Modified Mercalli Intensity for small epicentral distance in California.** Lee, V.W.; Trifunac, M.D. May 1987. NTIS, PC A15/MF A01 - GPO. Order Number DE87900766/JAW.

In Selection of earthquake resistant design criteria for nuclear power plants: methodology and technical cases: direct empirical scaling of response spectral amplitudes from various site and earthquake parameters.

Four regression equations describing the attenuation of Modified Mercalli Intensity (MMI) in terms of local earthquake magnitude, M, epicentral distance, R, focus depth, H, fault size, S, and the local geological conditions at the recording site (s = 0 for alluvium, s = 2 for basement rocks and s = 1 for intermediate sites) have been investigated. The equation (2.29): I/sub MM/ = 1.5 M - A - B ell n Δ - C Δ/100 - Ds where I/sub MM/ is the level on MMI scale and $\Delta = (R^2 + H^2 + S^2)^{1/2}$, leads to the best fit. For R = 0, H = 10 to 15 km and s = 0 the results of this equation become equivalent to I/sub MM/ = 1.5 M - 1.5 proposed by Gutenberg and Richter (1956). The predicted I/sub MM/ is about 1/2 intensity level higher for alluvium sites relative to the basement rock sites.

902 (NUREG/CR—4903-Vol.1, pp B.1-B.70) **Frequency dependent attenuation of strong earthquake ground motion.** Trifunac, M.D.; Lee, V.W. May 1987. NTIS, PC A15/MF A01 - GPO. Order Number DE87900766/JAW.

In Selection of earthquake resistant design criteria for nuclear power plants: methodology and technical cases: direct empirical scaling of response spectral amplitudes from various site and earthquake parameters.

New frequency dependent attenuation function of Fourier amplitude spectra of recorded strong earthquake ground acceleration has been developed. The iterative regression analyses assume simple functional forms to model the trends of the data and have sufficient flexibility to detect dependence of attenuation on source dimensions, depth and frequency of wave motion. It has been found that for distances less than about 100 km there is clear frequency dependent variation of attenuation functions, with high frequency amplitudes attenuating faster with distance. The strong motion data recorded so far is not adequate to describe attenuation of strong motion amplitudes for distances greater than about 150 km. To facilitate approximate characterization of attenuation of strong motion amplitudes for these and for larger distances it has been proposed to use the attenuation function developed by Richter for the computation of local magnitude scale in Southern California.

903 (NUREG/CR—4903-Vol.1, pp C.1-C.85) **Preliminary empirical model for scaling Fourier amplitude spectra of strong ground acceleration in terms of earthquake magnitude source to station distance, site intensity and recording site conditions: second paper.** Trifunac, M.D.; Lee, V.W. May 1987. NTIS, PC A15/MF A01 - GPO. Order Number DE87900766/JAW.

In Selection of earthquake resistant design criteria for nuclear power plants: methodology and technical cases: direct empirical scaling of response spectral amplitudes from various site and earthquake parameters.

In this paper, they present the current improvements in empirical scaling of Fourier spectrum amplitudes of strong earthquake accelerations by introducing the frequency dependent attenuation function which has been developed (Trifunac and Lee, 1985) from

the same data base. This function replaces the Richter's empirical attenuation function which they previously used together with a linear term in R, the epicentral distance. By using the new attenuation function, the scaling model has the additional flexibility for estimating the Fourier spectral amplitudes from earthquakes of given source dimensions and focal depths.

904 (NUREG/CR—4903-Vol.1, pp D.1-D.150) **Preliminary empirical models for scaling pseudo relative velocity spectra of strong earthquake accelerations in terms of magnitude, distance, site intensity and recording site conditions.** Trifunac, M.D.; Lee, V.W. May 1987. NTIS, PC A15/MF A01 - GPO. Order Number DE87900766/JAW.

In Selection of earthquake resistant design criteria for nuclear power plants: methodology and technical cases: direct empirical scaling of response spectral amplitudes from various site and earthquake parameters.

The authors previous empirical scaling model for Psendo Relative Velocity (PSV) spectrum amplitudes has been refined here by introducing the frequency dependent attenuation of amplitudes with distance (Trifunac and Lee, 1985a). The new model also considers the depth of earthquake focus and the approximate characterization of the source size to compute the representative source to station distances in addition to all other scaling parameters used previously (Trifunac and Anderson, 1977). The form of the probability distribution function of spectral amplitudes proposed by Trifunac and Anderson (1977) to describe the distribution of the residuals about the best regression model has been confirmed by this analysis.

905 (NUREG/CR—4903-Vol.2, pp I.1-I.54) **Review of quantitative procedures to obtain earthquake occurrence rates from rates of geological processes: application to the eastern United States.** Anderson, J.G. May 1987. NTIS, PC A09/MF A01 - GPO. Order Number DE87900767/JAW.

In Selection of earthquake resistant design criteria for nuclear power plants: methodology and technical cases: methods for introduction of geological data into characterization of active faults and seismicity and upgrading of the uniform risk spectrum technique.

This paper reviews the physical and experimental bases for a quantitative relationship between earthquake occurrence rates and geological deformation rates. In brief, these relationships are well founded on mathematical statement of the elastic rebound theory, and well supported by observations. A quantitative test for the adequacy of a historical catalog, motivated from results of Smith (1976), is presented. The role of aseismic creep, the width of the seismogenic zone, the shape of the earthquake magnitude - occurrence rate curve (including maximum earthquake), and the limitations of geological observations to define deformation rates are the most importance sources of uncertainty in the process. Anderson (1986) presented evidence consistent with the hypothesis that erosion and deposition rates might control the seismic strain rate, or might determine the lower bound for the seismic strain rate. This is one of the few hypotheses that allow for prediction of earthquake rates in the eastern US. This hypothesis might imply that earthquakes are without significance for tectonic deformation of the region and the widespread lack of surface faulting. It also might give a physical basis for estimates of the maximum earthquake, and allow for a (lower bound?) estimate of seismic hazard which is independent of the historical record of earthquakes.

906 (NUREG/CR—4903-Vol.2, pp II.1-II.122) **Uniform risk spectra of strong earthquake ground motion: NEQRISK.** Lee, V.W.; Trifunac, M.D. May 1987. NTIS, PC A09/MF A01 - GPO. Order Number DE87900767/JAW.

In Selection of earthquake resistant design criteria for nuclear power plants: methodology and technical cases: methods for introduction of geological data into characterization of active faults and seismicity and upgrading of the uniform risk spectrum technique.

The concept of uniform risk spectra of Anderson and Trifunac (1977) has been generalized to include (1) more refined description of earthquake source zones, (2) the uncertainties in estimating seismicity parameters a and b in $\log_{10} N = a - bM$, (3) to consider uncertainties in estimation of maximum earthquake size in each source zone, and to (4) include the most recent results on empirical scaling of strong motion amplitudes at a site. Examples of using to new NEQRISK program are presented and compared with the corresponding case studies of Anderson and Trifunac (1977). The organization of the computer program NEQRISK is also briefly described.

907 (NUREG/CR—4909) **MELPROG-PWR/MOD0: A mechanistic code for analysis of reactor core melt progression and vessel attack under severe accident conditions.** Camp, W.J.; Young, M.F.; Tomkins, J.L.; Kelly, J.E.; Maudlin, P.J.; Henninger, R.J. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety; Science Applications International Corp., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 155p. (SAND—85-0237). NTIS, PC A08/MF A01 - GPO. Order Number DE88000478/JAW.

Since the Three Mile Island accident, increased emphasis has been placed on the analysis of severe reactor accidents because such accidents represent the dominant public risk from nuclear reactors. The US Nuclear Regulatory Commission has made the development of mechanistic models for severe accident progression a major priority. The purpose of these models is to provide detailed, best-estimate, coupled analyses of all the major phenomena involved in the reactor vessel and coolant system in the course of the accident. To meet this objective, the MELPROG computer code is being developed. The initial version of this code, MELPROG-PWR/MOD0, is described in this report. The purpose of MELPROG is to provide at any time during an accident sequence a description of (1) the state of the reactor core and surrounding in-vessel environment, and (2) the disposition of core materials (in particular, fission products) contained within the reactor coolant system boundary. MELPROG is coupled to the TRAC-PF1 RCS thermal-hydraulics code to provide an integrated analysis of the behavior of core, vessel, and reactor coolant system during severe accidents. MELPROG treats core degradation and loss of geometry, debris formation, core melting, attack on supporting structures, slumping, melt/water interactions and vessel failure. The key element in MELPROG is the use of detailed modeling for the entire damage progression and failure sequence. Emphasis is also placed on the rates of hydrogen, steam and fission product formation, and transport to containment during damage progression.

908 (NUREG/CR—5006) **PRA [Probabilistic Risk Assessment] Applications Program for inspection at Oconee Unit 3.** Gore, B.F.; Vo, T.V.; Harris, M.S. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). Oct 1987. Contract AC06-76RL01830. 59p. NTIS, PC A04/MF A01 - GPO. Order Number DE88001343/JAW.

The extensive Oconee-3 PRA performed by EPRI has been analyzed to identify plant systems and components important to minimizing public risk, and to identify the primary failure modes of these components. This information has been tabulated, and correlated with inspection modules from the NRC Inspection and Enforcement Manual. The report presents a series of tables, organized by system and prioritized by public risk (in person-rem per year), which identify components associated with 98% of the inspectable risk due to plant operation. External events (earthquakes, tornadoes, fires and floods) are not addressed because inspections cannot directly minimize the risks from these events; however, flooding caused by the breach of internal systems is addressed. The systems addressed, in descending order of risk importance, are: Reactor Building Spray, R B Cooling, Condenser Circulating Water, Safety Relief Valves, Low Pressure Injection, Standby Shutdown Facility-High Pressure Injection, Low-Pressure Service Water, and Emergency Feedwater. This ranking is based on the Fussel-Vesely measure of risk importance, i.e., the fraction of the total risk which involves failures of the system of interest. 8 refs., 25 tabs.

909 **(ORNL/TM—1372/S1) HFIR [High Flux Isotope Reactor] pressure vessel and structural components materials surveillance program: Supplement 1.** Cheverton, R.D.; McGinty, D.M.; McWherter, J.R.; Nanstad, R.K. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001593/JAW.

Extending the life of the HFIR vessel by the proposed 10 effective full-power years is contingent upon a continuation of the materials surveillance program and the application of hydrostatic proof testing. As a part of the surveillance program, Charpy V-notch (CVN) specimens of shell, weld and nozzle materials are installed adjacent to the inner surface of the vessel and are removed periodically for testing to determine the radiation-induced increase in the nil-ductility transition temperature. Hydro testing is conducted to prove that a critical combination of flaw size, stress and fracture toughness does not exist. Information from the materials surveillance program is used in a fracture mechanics analysis to confirm that the hydro-test pressure being applied is appropriate for the desired life extension of the vessel. This report specifies (1) the number, type, location and schedule for removal-testing of the CVN specimens for the continuing materials surveillance program, and (2) the procedures and test conditions for the hydro test.

910 **(PNL—6335) Assessment of foreign decommissioning technology with potential application to US decommissioning needs.** Allen, R.P.; Konzek, G.J.; Schneider, K.J.; Smith, R.I. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000800/JAW.

This study was conducted by the Pacific Northwest Laboratory (PNL) for the US Department of Energy (DOE) to identify and technically assess foreign decommissioning technology developments that may represent significant improvements over decommissioning technology currently available or under development in the United States. Technology need areas for nuclear power reactor decommissioning operations were identified and prioritized using the results of past light water reactor (LWR) decommissioning studies to quantitatively evaluate the potential for reducing cost and decommissioning worker radiation dose for each major decommissioning activity. Based on these identified needs, current foreign decommissioning technologies of potential interest to the US were identified through personal contacts and the collection and review of an extensive body of decommissioning literature. These technologies were then assessed qualitatively to evaluate their uniqueness, potential for a significant reduction in decommissioning costs and/or worker radiation dose, development status, and other factors affecting their value and applicability to US needs.

911 **(SRD/R—393) A theoretical study of NH_3 concentrations in moist air arising from accidental releases of liquefied NH_3 using the computer code TRAUMA.** Wheatley, C.J. (UKAEA Safety and Reliability Directorate, Culcheth). Feb 1987. 51p. United Kingdom Atomic Energy Authority, Wigshaw Lane, Culcheth, Warrington WA3 4NE. Order Number TI88900116/JAW.

The computer code TRAUMA calculates the consequences of accidentally releasing liquefied ammonia, either refrigerated or pressurized, into moist atmospheres through a pipe or tank wall rupture. In this report, TRAUMA is used to study four accidental releases typical of the spectrum of those which might need to be considered in safety assessments of installations at which it is stored. These are: release of presurized ammonia (its temperature is ambient) through a pipe and through a tank wall rupture; release of refrigerated ammonia (at its boiling point) through a pipe; and release of semi-refrigerated ammonia (at 0°C) through a pipe. Results for discharge rates and speeds; flashing at the outlet; drop sizes and settling speeds; and entrainment of air are presented and discussed. Outstanding uncertainties are summarized. Despite these, it is concluded that TRAUMA can be used to obtain valuable information concerning the safe storage of ammonia in a wide range of circumstances. 1 ref., 35 figs., 2 tabs.

912 **(UCID—21016) How adequate are your procedures?.** Paramore, B.; Petersen, L.R.; Banks, W.W. (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 55p. NTIS, PC A04. Order Number DE88001329/JAW.

Procedures are important to operators and to plant safety, reliability, and availability. Procedure improvement and validation is a continuous process which requires the support of management, training, operations, safety and design engineering. The payoff is high when compared with the risks involved if management chooses not to take an informed approach. Human engineering design concepts are perfectly compatible with efforts to improve and enhance procedures since, ultimately, it is the operator or maintenance technician who must read, understand, follow and execute procedures steps. This report reviews the concepts of adequate procedures and provides aids to review and validate existing procedures.

913 **Shippingport Station Decommissioning Project overview.** Usher, J.M. (Shippingport Decommissioning Project Office, Shippingport, PA). pp 76-81 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—).

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The U.S. Department of Energy (DOE) is in the process of decommissioning the Shippingport Atomic Power Station (SAPS), the first commercial-sized nuclear power plant in the United States to undergo complete dimantlement. SAPS is located near Pittsburgh, Pennsylvania on approximately seven acres of land owned by Duquesne Light Company (DLC), and leased to the U.S. Department of Energy. The Station consists of a 275' x 60' Fuel Handling Building containing the Reactor Containment Chamber, the Service Building, the Turbine Building, the Radioactive Waste Processing Building, The Administration Building, and other smaller support buildings. The Station has four coolant loops; most of the containment structures are located below grade. Shippingport Station was shutdown in October, 1982. Defueling operations began in 1983 and were completed by September, 1984. A caretaker and site preparation period lasted from September, 1984 to September, 1985, at which time decommissioning activities started. The decommissioning period is scheduled as September, 1985 through April, 1990. Project total estimated cost is $98.3 million.

914 **Cask development, testing, and licensing.** Quinn, G.J.; Haelsig, R.T.; Warrant, M.M. (Idaho National Engineering Lab., EG and G Idaho, Inc.). pp 614 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—).

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The NuPac 125-B Rail Cask was developed to provide a safe means of transporting the damaged core of Three Mile Island Unit 2 from the TMI site at Middletown, PA, to the Idaho National Engineering laboratory (INEL) at Idaho Falls, ID. The development of the NuPac 125-B Rail Cask posed two engineering and technical management challenges; Licensing Strategy - The NuPac 125-B Rail Cask represented the first irradiated fuel rail cask developed within the United States in the past decade, a decade characterized by changing nuclear regulations, and Accelerated Schedule - The TMI-2 defueling schedule demanded a cask development schedule one-third as long as normally required. These challenges governed the overall development and licensing process for the cask. First, a high degree of conservation was incorporated into the design to allow quick, simplified demonstrations of adequacy to regulatory staff. Second, redundant design techniques were employed in all areas of uncertainty. The testing program eliminated performance uncertainties and validated predictions and predictive models. Drop tests of a quarter-scale model of the cask were conducted, and results were correlated with analytic predictions to verify structural and mechanical performance of the cask. Full-scale tests of the canisters were conducted to verify structural behavior of canister inter-

nals which provide criticality control. This paper describes the testing program for the NuPac 125-B Rail Cask, presents results therefrom, and correlates findings with Regulation 10 CFR 71 of the U.S. Nuclear Regulatory Commission.

915 **Shippingport Station Decommissioning Project start of physical decommissioning.** Crimi, F.P. (Decommissioning Services, General Electric Co., Nuclear Energy Business Operation, Shippingport, PA). pp 82-88 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—).

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

This paper describes the current status of the physical decommissioning work, which started September 1985. The preparations required to start a major decommissioning work effort in a safe and cost effective manner are discussed including the development of integrated detailed schedules, manpower and cost estimates, and implementation of a cost/schedule control system. The detailed plan required to ensure that people, property, and procedures are ready in sufficient time to support the start of physical decommissioning is also discussed. The total estimated cost of the Shippingport Station Decommissioning Project should be $98.3 M, with the Project scheduled for completion in April 1990. At the decommissioning of the first commercial-sale nuclear power plant, the Shippingport Project is expected to set the standard for safe, cost-effective demolition of nuclear plants.

916 **Release criteria for decommissioning of the Shippingport Atomic Power Station.** Eger, K.J.; Gardner, D.L.; Giordano, R.J. (Nuclear Energy Business Operations, General Electric Co., Shippingport, PA). pp 97-102 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—).

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The United States Department of Energy (DOE) has established guidelines for allowable levels of residual radioactivity at remote sites in the Surplus Facilities Management Program (SFMP). These guidelines specify that doses to the public from this residual radioactivity must not exceed 500 mrem/year (for up to five years) or 100 mrem/year (for a lifetime), regardless of the use of the land. The guidelines also specify that exposures be further limited, depending on ALARA considerations. A cost-benefit analysis, based on actual conditions at Shippingport, is being prepared to identify these "low-enough" concentrations. These concentrations comprise the release criteria for the site. The analysis is developed by performing an initial site characterization, employing pathways analyses to compute the dose to a future occupant, costing of proposed site modifications, and repeating a pathways analysis based on each "as-modified" location on the site. The result are paired set of data relating the cost of modification to the reduction in the dose to the occupant. In this paper, details in each of the four major steps needed to prepare the cost-benefit analysis are discussed, as well as the sampling plan and estimated costs for site characterization.

917 **Core restraint contributions to radial expansion reactivity.** Moran, T.J. (Argonne National Lab.). pp 454-458 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—).

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

Bowing of core assemblies caused by thermal gradients, swelling gradients, and irradiation creep can cause significant changes in reactivity of an LMFBR during startup, overpower and loss-of-flow without scram transients. This paper summarizes calculations of bowing reactivity effects for both a small homogenous and a small heterogeneous core design. It includes two core restraint concepts for each core design and concentrates on reactivity changes in the critical power-to-flow range of 1.0 t 2.0.

918 **TMI-2 core boring machine.** Croft, K.M.; Helbert, H.J.; Laney, W.M. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415). pp 516-522 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—). Contract AC07-76ID01570.

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

An important and essential aspect of the TMI-2 defueling effort is to determine what occurred in the core region during the accident. Remote cameras and probes only portray a portion of the overall picture. What lies beneath the rubble bed and solidified sublayer is, as yet, unknown. This paper discusses the TMI-2 Core Boring Machine, which has been developed to drill into the damaged core of the TMI-2 reactor and extract stratified samples of the core. This machine, its unique support structure, positioning and leveling systems, and specially designed drill bits, combine to provide a unique mechanical system. In addition, the machine is controlled by a microprocessor; which actually controls the drilling operation, allowing relatively inexperienced operators to drill the core samples. A data acquisition system is data integral with the controlling system and collects data relative to system conditions and monitored parameters during drilling. Data obtained during the actual drilling operations are collected in a data base which will be used for actual mapping of the core region, identifying materials and stratification levels that are present.

919 **Reactor closure design for a pool-type fast reactor.** Chung, H.; Seidensticker, R.W.; Kann, W.J.; Bump, T.R.; Schatmeier, C. (Argonne National Lab., Argonne, IL 60439). pp 490-498 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—).

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The reactor closure is the topmost structural part of a reactor module. For a pool-type fast reactor it is an especially important structure because it provide the interface between the primary coolant system and the main access area above the closure. The reactor closure comprises a stationary deck, a rotatable plug, the boundary elements of primary system and containment penetrations for equipment and auxiliary systems. This paper evaluates two different reactor closure design concepts, referred to as "warm" deck and "hot" deck, for a pool-type fast reactor with respect to their design features, technical merits, and economic benefits. The evaluation also includes functional, structural, and thermal analysis of the two deck design concepts. Issues related to their fabrication and shipping to the plant site are also addressed.

920 **Seismic analysis of a large-pool type LMFBR concept.** Means, R.T.; Urko, W. (Combustion Engineering). pp 471-478 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—).

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The reactor assembly structure of a large pool-type LMFBR constitutes the primary structural boundary and support for the reactor system and sodium coolant. It must satisfy the conflicting requirements of structural flexibility to minimize thermal stress and structural stiffness to minimize seismic response and withstand seismic loading on a wide range of nuclear plant sites. In addition, fluid-structure interaction involving submerged components (e.g., reactor core and assembly, lower internals structures, upper internal structure, etc.) and the interface between the fluid and the thin-walled vessel must be addressed. This paper describes the preliminary analytic approach to the seismic analysis of a large pool-type LMFBR. This approach uses the response spectra model analysis method with an axisymmetric finite element shell model. The model comprises structural and fluid finite elements in order to account for the fluid-structure interaction.

921 **Bowing of core assemblies in advanced liquid metal fast reactors.** Kamal, S.A.; Orechwa, Y. (Applied Physics Div., Argonne National Lab., Argonne, IL 60439). pp 446-453 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—). Contract W-31-109-ENG-38.

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

Two alternative core restraint concepts are considered for a conceptual design of a 900 MWth liquid metal fast reactor core with a heterogeneous layout. The two concepts, known as limited free bowing and free flowering, are evaluated based on core bowing criteria that emphasize the enhancement of inherent reactor safety. The core reactivity change during a postulated loss of flow transient is calculated in terms of the lateral displacements and displacement-reactivity-worths of the individual assemblies. The NUBOW-3D computer code is utilized to determine the assembly deformations and interassembly forces that arise when the assemblies are subjected to temperature gradients and irradiation induced creep and swelling during the reactor operation. Whereas both restraint systems meet the bowing criteria, a properly designed limited free bowing system appears to be more advantageous than a free flowering system from the point of view of enhancing the reactor inherent safety.

922 **Structural analysis of fuel assembly clads for the upgraded transient reactor test facility: TREAT Upgrade.** Ewing, T.F.; Wu, T.S. (ETA, Inc., 415 E. Plaza Drive, Westmont, IL 60559). pp 459-463 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—).

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The Upgraded Transient Reactor Test Facility (TREAT Upgrade) is designed to test full length, pre-irradiated fuel pins of the type used in large LMFBRs under accident conditions, such as severe transient overpower and loss-of-coolant accidents. In TREAT Upgrade, the central core region is to contain new fuel assemblies of higher fissile loadings to maximize the energy deposition to the test fuel. These fuel assemblies must withstand normal peak clad temperatures of 860°C for hundreds of test transients. Due to high temperatures and gradients predicted in the clad, creep and plastic strain effects are significant, and the clad structural behavior cannot be analyzed by conventional linear techniques. Instead, the detailed elastic-plastic-creep behavior must be followed along the time-dependent load history. This paper presents a general summary of the structural evaluations of the conceptual TREAT Upgrade fuel assembly clads.

923 **Core sampling: A driller's dilemma.** Martin, M.R. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415). pp 599-603 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—). Contract AC07-76ID01570.

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

Sampling of core materials inside the TMI-2 reactor vessel can supply invaluable data to aid in reconstructing the damage sequence. This paper describes the problems faced in developing a drilling rig to collect samples of the damaged core. These problems include uncertainties as to precise core conditions, variability in core consistency (soft metals coexisting with metals harder than tungsten carbide), and the adaptation of existing drilling technology to accomplish a unique and difficult task.

924 **Fuel removal, transport, and storage.** Reno, H.W. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID 83415). pp 604-613 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—). Contract AC07-76ID01570.

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The March 1979 accident at Unit 2 of the Three Mile Island Nuclear Power Station (TMI-2) which damaged the core of the reactor resulted in numerous scientific and technical challenges. Some of those challenges involved removing the core debris from the reactor, packaging it into canisters, loading canisters into a rail cask, and transporting the debris to the Idaho National Engineering Laboratory (INEL) for storage, examination, and preparation for final disposal. This paper highlights how some challenges were resolved, including lessons learned and benefits derived therefrom. Key to some success at TMI was designing, testing, fabricating, and licensing two rail casks, which each provide double containment of the damaged fuel.

925 **TMI-2: From accident to recovery - A regulatory perspective.** Grant, P.J. (Idaho National Engineering Lab., EG and G Idaho, Inc.). pp 591 of Proceedings of the 1986 joint ASME/ANS nuclear power conference. La Grange Park, IL; American Nuclear Society (1986). (CONF-860724—).

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The accident which damaged Unit 2 of the Three Mile Island Nuclear Power Station caused ripples through the domestic and international nuclear communities which will be felt for years to come. Most of what has been and is being accomplished in TMI-2 is precedent-setting. This paper discusses past and present regulatory issues related to TMI-2, and summarizes technologies developed for and applied to Unit 2 which resolved or will resolve those issues.

926 **(BNL-tr—1060) Consequences of the embrittlement of channels following neutron irradiation in a High Flux Reactor.** Bauer, E. (Institut Max von Laue - Paul Langevin, 75 - Paris (France)). [1987]. Contract AC02-76CH00016. Translation of EB/od-81-89, Feb. 4, 1981. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001540/JAW.

Channel failure is an incident that the reactor design takes into account and whose consequences have been studied and accepted during the safety analysis of the facilities. The study of the failure modes (Chapter 3) has shown that the embrittlement of the material due to neutron irradiation does not constitute a fact that could fundamentally change the probability of failure compared to a new reactor. The mechanical properties of the irradiated material in elastic regime are not below the values of the new material. In this respect, the second part of the AG3 NET - HFR test program, whose results are available, does not raise concerns, given the very high mechanical properties of the irradiated material. Consequently, no preventive provisions have to be made, since the irradiated material is compatible with its use as structural material for the channels. The study of the failure modes also demonstrated that mechanical blows applied to irradiated material could lead to destruction because of the reduced plastic deformability. However, this risk only arises when the reactor is shut down during maintenance operations that require access to equipment placed inside the channels.

25 ENERGY STORAGE

REFER ALSO TO CITATION(S) 1161

927 **(N—87-26530) Expert systems applied to fault isolation and energy storage management, phase 2. Final report.** (Martin Marietta Corp., Baltimore, MD (USA)). 1987. 386p. (NASA-CR—179136; NAS—1.26:179136; MCR—85-641). NTIS, PC A17/MF A01.

A user's guide for the Fault Isolation and Energy Storage (FIES) II system is provided. Included are a brief discussion of the background and scope of this project, a discussion of basic and advanced operating installation and problem determination procedures for the FIES II system and information on hardware and software

design and implementation. A number of appendices are provided including a detailed specification for the microprocessor software, a detailed description of the expert system rule base and a description and listings of the LISP interface software.

2501 Magnetic

REFER ALSO TO CITATION(S) 1091

2506 Thermal

REFER ALSO TO CITATION(S) 1105

928 **(PNL-SA—14929) Effects of stratification on thermal energy storage in aquifers.** Kannberg, L.D.; Vail, L.W. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 6p. (CONF-870804—40). NTIS, PC A02. Order Number DE88000095/JAW.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

A study was conducted to evaluate the impacts of aquifer stratification on the thermal energy recovery efficiency of aquifers being used as thermal energy storage reservoirs. A geohydrothermal model was applied parametrically for idealized aquifers having perfect hydraulic stratification (i.e., no fluid transfer between layers). The recovery efficiency is displayed as a function of Fourier number for idealized aquifers having alternating permeable and impermeable layers. Three ratios of impermeable to permeable layer thicknesses were evaluated. Results are presented for the first and fifth operation cycles. A clearly defined minimum recovery efficiency is observed as a function of Fourier number with the minimum occurring for Fourier numbers between 0.1 and 1. Significant improvement in energy recovery is evident between the first and fifth cycles. Simple methods of utilizing the results are presented. Stratification degrades the performance of the system. Stratification can be expected to be a significant factor for many aquifer thermal energy storage systems because aquifer layering will frequently have thicknesses for which stratification effects are most severe (between 0.3 and 5 m).

2508 Chemical

929 **(AD-A—183010/8/XAB) High-temperature chemistry of stored-chemical energy reactions for propulsion. Annual report, 25 May 1985-31 December 1986.** Cook, L.P.; Plante, E.R.; Bonnell, D.W.; Hastie, J.W. (National Bureau of Standards, Washington, DC (USA). Ceramics Div.). Jul 1987. 57p. (NBSIR—87-3601). NTIS, PC A04/MF A01.

This report summarizes the results of a continuing study of the high-temperature chemistry of stored-chemical-energy reaction systems. Thermogravimetric studies were completed on the behavior of aluminum oxide and magnesium oxide in the presence of ClO_3F. Based on these data, a new ceramic containment systme comprised of alumina and magnesia parts allowed extension of kinetic experiments from the 650 C limit previously encountered to a temperature in excess of 800 C. Using the new apparatus, the authors observed the relative inertness of the Al component of the fuel to oxidation by ClO_3F even at 800 C. They also noted the extensive vapor-phase transport of lithium fluoride and magnesium flouride not expected on the basis of known thermodynamic data. Thermogravimetric experiments were completed on the oxidation of molten aluminum droplets by ClO_3F. Rate data for this reaction indicate multiple mechanisms, possibly including the following steps: (1) nucleation and growth of AlF_3 precipitation sites; (2) edge growth of AlF_3 islands followed by coalescence of islands; (3) diffusion limited thickening of the AlF_3 layer. Observations on the early stages of the Al/ClO_3F reaction have also been made using high-pressure-sampling transpiration mass spectrometry.

2509 Batteries

930 **(AD-A—183110/6/XAB) Impedance studies of the cell Ag/Ag beta' alumina/Ag. Technical report, September 1986-August 1987.** Breiter, M.W.; Drstak, H.; Maly-Schreiber, M. (Technische Univ., Vienna (Austria). Inst. fuer Technische Elektrochemie). 1 Jul 1987. 20p. (TR—11). NTIS, PC A02/MF A01.

Measurements of the cell impedance were carried out at constant temperature between 25 and 450 C at frequencies between .01 and .0001 Hz. The surfaces of the solid electrolyte obtained by exchanging the sodium ions of the starting material, sodium beta alumina from Ceramatec Inc., with silver ions in molten silver nitrate, were either polished or saw cut. Silver electrodes were attached by silver paint after applying the initial silver layer by sputtering. The silver electrodes display the behavior of a blocking electrode in a wide frequency range at temperatures below about 200 C. This behavior is clearer pronounced on the polished surfaces. The saw cut surfaces show an intermediate behavior between blocking and non-blocking electrodes. A transition from blocking to non-blocking electrode occurs between 150 and 200 C for both types of surfaces. The impedance data are analyzed in the lower temperature range by an analogue network.

931 **(SAND—87-0707) Corrosion susceptibility study of candidate pin materials for ALTC [active lithium/thionyl chloride] batteries.** Bovard, F.S.; Cieslak, W.R. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001449/JAW.

(ALTC = active lithium/thionyl chloride.) We have investigated the corrosion susceptibilities of eight alternate battery pin materials in 1.5M $LiAlCl_4/SOCl_2$ electrolyte using ampule exposure and electrochemical tests. The thermal expansion coefficients of these candidate materials are expected to match Sandia-developed Li-corrosion resistant glasses. The corrosion resistances of the candidate materials, which included three stainless steels (15-5 PH, 17-4 PH, and 446), three Fe-Ni glass sealing alloys (Kovar, Alloy 52, and Niromet 426), a Ni-based alloy (Hastelloy B-2) and a zirconium-based alloy (Zircaloy), were compared to the reference materials Ni and 316L SS. All of the candidate materials showed some evidence of corrosion and, therefore, did not perform as well as the reference materials. The Hastelloy B-2 and Zircaloy are clearly unacceptable materials for this application. Of the remaining alternate materials, the 446 SS and Alloy 52 are the most promising candidates.

932 **(SAND—87-0924C) Reliability of Li/SO_2 cells for long-life applications.** Levy, S.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871027—37). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001360/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Commercial Li/SO_2 cells and cells with various modifications to improve long-life performance and reliability were placed on a real-time test of up to six years duration. Analysis of the results has indicated the primary mode of failure to be corrosion of the glass in the glass-to-metal seal. Use of a corrosion-resistant glass has resulted in a significant improvement in both performance and reliability. Units deployed in the field have demonstrated a reliability of >0.999 using cells containing all the Sandia developed modifications.

933 **(SAND—87-1106C) Impedance of passive lithium anodes in $SOCl_2$ solutions under low-field polarization.** Delnick, F.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-871027—35). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000922/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Passive films on lithium anodes in $Li/SOCl_2$ batteries inhibit the kinetic response of the batteries. Under potentiostatic polarization, passive lithium anodes exhibit "current delay;" and under gal-

vanostatic polarization, they exhibit "voltage delay." In this report, low-field potentiostatic polarization and complex impedance measurements are used to determine the mechanism of current delay. The time-dependent transition in the current is caused by the injection of excess cation defects into the film. These excess defects decrease the film resistance and repartition the overvoltage to the LiCl/$SOCl_2$ interface. The enhanced defect concentration at this interface and/or the enhanced field accelerate the dissipation of the film. 11 figs.

934 **(TVA/PUB—87/19) Nickel-iron electric vehicle battery applications workshop: Proceedings.** Douglas, D.L. (Douglas (David L.), Inc., Bloomington, MN (USA); Electric Power Research Inst., Palo Alto, CA (USA); Tennessee Valley Authority, Chattanooga (USA)). May 1987. 306p. (RP—2415-4; CONF-8705197—). NTIS, PC A14/MF A01. Order Number DE88900017/JAW.

From Nickel-iron electric vehicle battery applications workshop; Chattanooga, TN, USA (27 May 1987).

This report presents information concerning nickel-iron batteries. Different sections discuss the development of the battery, manufacture of the battery, and performance of the battery especially as applied to use in electric-powered vehicles. 181 figs., 15 tabs. (JDH)

935 **Refractory lining for electrochemical cell.** Blander, M.; Cook, G.M. (to Dept. of Energy, Washington, DC). US Patent 4,687,564. 18 Aug 1987. Filed date 21 May 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes an apparatus for processing a melt of molten iron in contact with a molten slag containing iron oxide, the apparatus consists of melt containing means including an electrically conductive refractory lining disposed for contact with an iron oxide containing melt, an anode in the melt containing means electrically separated from the refractory lining, and means for establishing a voltage between the refractory lining as cathode and the anode to reduce iron oxide to iron at the surface of the refractory lining in contact with the iron oxide containing melt, the refractory lining including a metal oxide selected from the group consisting of Mg chromites and MgO.

936 **Sulfonated polysulfone battery membrane for use in corrosive environments.** Arnold, C. Jr.; Assink, R. (to Dept. of Energy). US Patent Application 6-918,194. 1987. 16p. Contract AC04-76DP00789. DE88000876 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000876/JAW.

For batteries containing strong oxidizing electrolyte and a membrane separating two electrolyte solutions, e.g., a zinc ferricyanide battery, an improved membrane is provided comprising an oxidative resistant, conductive, ion-selective membrane fabricated from a catenated aromatic polymer having an absence of tertiary hydrogens, e.g., a sulfonated polysulfone.

937 **An advanced lithium-aluminum/iron disulfide secondary cell.** Kaun, T.D. (Argonne National Lab., Chemical Technology Div., 9700 S. Cass Avenue, Argonne, IL 60439). pp 16-22 of Proceedings of the 32nd international power sources symposium. Pennington, NJ; The Electrochemical Society (1986). (CONF-860688—). Contract W-31-109-ENG-38.

From 32. NASA/US Army international power sources symposium; Cherry Hill, NJ, USA (8 Jun 1986).

The use of the dense U.P. -FeS/sub 2/ electrode and the lower-melting LiCl-LiBr-KBr electrolyte has eliminated the capacity-loss problem of the Li-Al/FeS/sub 2/ system; with LiCl-KCl electrolyte, the cell would have lost 30% of its capacity in the first 200 cycles. At the same time, the cell performance has been increased significantly. Based on the improved performance, a 250-Ah monopolar cell is expected to achieve a specific energy of 175 Wh/kg at a 4-h rate and specific power of 200 W/kg at 80% DOD. An advanced bipolar battery design has a projected capability of 200 Wh/kg at a 1-h rate with 600 W/kg at 80% DOD, and a battery specifically designed for continuous high power output is projected to provide greater than 2000 W/kg. These bipolar batteries can be operated nearly isothermally because the unique entropic cooling of the upper-plateau FeS/sub 2/ discharge reaction cancels I/sup 2/R heating. The dense upper plateau FeS/sub 2/ cell with its high performance and durability poses exciting possibilities for demanding battery applications such as electric vehicles, stationary energy storage, and satellites.

938 **Activity coefficients in concentrated potassium hydroxide - potassium zincate electrolytes.** Isaacson, M.J.; Cairns, E.J.; McLarnon, F.R. (Applied Science Div., Lawrence Berkeley Lab., Dept. of Chemical Engineering, Univ. of California, Berkeley, CA 94720). pp 12080-12081 of Proceedings of the International Society of Electrochemistry 36th meeting (Extended Abstracts). Graz, Austria; International Society of Electrochemistry (1985). (CONF-8509386—Summs.).

From 36. meeting of the International Society of Electrochemistry; Salamanca, Spain (23 Sep 1985).

Concentrated potassium hydroxide-potassium zincate electrolyte has been the favored electrolyte for secondary zinc/air and zinc/nickel oxide batteries. Despite the large amount of research done on rechargable zinc cells over the past two decades, the electrolyte activity and osmotic coefficients are not published. Several authors have published activity coefficients calculated from zinc potential measurements. However, these calculations assume that the zincate ion does not specifically affect the hydroxide activity. The purpose of this work is to calculate the activity coefficients without relying on this assumption. There are three components, so two independent activity measurements must be made. The Zn/HgO cell potential is one activity measurement, and the alpha-Pd/HgO cell potential is being investigated as the other measurement. It is demonstrated that H/sub 2/(Pt)/HgO cell potentials may also be used. The activity and osmotic coefficients are calculated from the potentials by numerically integrating the Gibbs-Duhem equation.

29 ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 1124

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 997, 1000, 1003, 1030

939 **(BMFT-FB-T—86-184) Energy analysis of wood-based industry in the Federal Republic of Germany. Final report.** Ressel, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bundesforschungsanstalt fuer Forst- und Holzwirtschaft, Hamburg (Germany, F.R.). Inst. fuer Holzphysik und Mechanische Technologie des Holzes). Dec 1986. 162p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87753254/JAW.

In this investigation the energy consumption in wood and wood-based industry of the Federal Republic of Germany is presented. In view of increasing energy costs the collected data should facilitate a relevant and field-proven promotion of projects regarding energy saving in the wood industry. In account of the many different products and process technologies it seemed to be necessary to limit this investigation to production of sawn and planed timber, gluelam beams, veneers, particle boards, plywood and furniture. The published results are founded on inquiries of selected enterprises in the above mentioned production fields. Except for the furniture industry characteristic figures for thermal and electrical energy consumption related to particular final products are presented. Regarding furniture industry the characteristic figures are related to man hours required. Fields of main energy consumption in enterprises of these branches are described. SANKEY-diagrams display these fields using model plants. The total energy consumption of the wood industry in the Federal Republic is calculated using figures of the official statistics of the presented characteristic figures. It is emphasized that wood residues - they are not included in the statistics - play an important role in energy generation in plants of the wood industry. Finally, the total energy consumption is com-

pared with energy consumption in other fields of the producing industry. The investigation is completed by a catalog of possible methods for reducing energy consumption. With 78 refs., 48 tabs., 39 figs.

940 **(ESC—42) National energy outlook 1987.** Bruggink, J.J.; Boonekamp, P.G.M.; Bakema, G.F.; Verhagen, L.; Kroon, P.; van Oostvoorn, F. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Sep 1987. 241p. (In Dutch). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88750037/JAW.

The National Energy Outlook 1987 contains a set of three energy scenarios describing a range of plausible developments of the Dutch energy sector up to the year 2010. The scenarios indicate the range of uncontrollable uncertainties which energy policy makers face when making strategic decisions. For each scenario three policy cases are developed, in which the degree fuel diversification is different. These are termed the nuclear, coal and gas cases, indicating the central role of the respective energy carriers in each case. The goal of the National Energy Outlook 1987 is to analyze the potential economic and environmental consequences of the different scenarios and cases in order to provide energy policy makers with strategic information for policy purposes. Although the cost of energy supply may increase drastically, the share of these costs in total GNP will fall in all scenarios and cases, because of substantial energy savings and structural changes in the economy. The only potential for fuel substitution is in public power generation and large-scale industrial steam production. Therefore the study has paid much attention to the mutual relation between the costs of public electricity production and the potential for industrial cogeneration. The penetration of renewable energy sources will be limited. Environmental problems will become severe when no additional policy measures are taken. Expensive measures are required to bring emissions down to acceptable levels. A critical reserves-production ratio for domestic natural gas will be reached soon after the turn of the century. For the gas case around 2005, for the coal and nuclear cases around 2015.

941 **(Juel-Spez—385) Program of research and development on the utilization of Brazilian coal and on energy systems analysis and planning for Brazil. Final report.** Aringhoff, R.; Kolb, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung). Dec 1986. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753266/JAW.

Up to now Brazilian coal is only used in conventional powerplants without preceding preparation (5-6 Mio t/a). The potential of an extended coal utilization was not quantified. Therefore the project had the following aims: 1. Transfer of an energy supply model and conduct of a study on the potential of coal utilization within the entire Brazilian energy economy. 2. Quantification of the characteristics of the two most important types of coal and of the most appropriate preparation technologies. 3. Derivation of technical-economical data for different coal derived products. 4. Basic engineering for the reconstruction of the power plant Sao Jeronimo into an atmospheric fluidized bed combustion (AFBC) unit. 5. Potential for atmospheric fluidized bed combustion in the Brazilian industry. The energy planning study was conducted with the linear programming model MARKAL. For items (2) and (3) test results with Brazilian coal and available experience were used. (5) Is based on data collected by the Brazilian National Oil Council in an enquiry at 2300 companies.

942 **Overview of IDES: An integrated demand and energy supply equilibrium model.** Macal, C.M. (Argonne National Lab., IL, USA). pp 17-30 of Strategic planning in energy and natural resources. Lev, B. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (North-Holland) (1987). (CONF-8604185—). Contract W-31-109-ENG-38.

From 2. symposium on analytic techniques for energy, natural resources, and environmental planning; Philadelphia, PA, USA (3 Apr 1986).

The IDES (Integrated Demand and Energy Supply) model is a price-quantity equilibrium model, similar to the Long-Term Energy Analysis Package (LEAP), for projecting energy quantities and prices over a time horizon of up to 30 years. The model integrates resource production activities, petroleum refining, electricity generation, fuel processing, and energy demand. Unlike most energy equilibrium models, IDES is designed to be small enough to run on a microcomputer, as well as on a mainframe computer. This paper describes the model's design objectives, mathematical formulation, iterative solution algorithm, and computer implementation. 4 figs., 11 refs.

943 **Energy policy analysis on a personal computer.** Roop, J.M.; Belzer, D.B. (Pacific Northwest Lab., Richland, WA, USA). pp 171-179 of Strategic planning in energy and natural resources. Lev, B. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (North-Holland) (1987). (CONF-8604185—). Contract AC06-76RL01830.

From 2. symposium on analytic techniques for energy, natural resources, and environmental planning; Philadelphia, PA, USA (3 Apr 1986).

An energy policy analysis tool for the personal computer has been developed by Battelle's Pacific Northwest Laboratory (PNL) for the U.S. Department of Energy. This tool is called the Sectoral Energy Analysis and Data System (SEADS-PC). The software package requires that the policy under investigation be translated into: changes in components of Gross National Product; a change in industry final demand; or a change in energy intensity in specific industries. SEADS-PC then converts these policy implications into changes in energy use in the U.S. economy. These changes are analyzed through an input-output representation of the U.S. economy that includes over 100 industries. An application of SEADS-PC to the energy consequences of balancing the federal budget suggests that the energy effects would be slight, but that petroleum use would increase relatively more than other fuels. A second application shows that as a result of petroleum intensity declines over the period 1972-1981, the economy used 4.6 quad (51.4 percent) less oil in 1981.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 15, 199, 304, 390, 397, 455, 460, 469, 533, 597, 997, 1010, 1125, 1733, 1841

944 **(IFP—34-548) Effects of the variations in energy prices on the economical structures. The cases of the American and Japanese industries (1970-1982).** Gaildraud, I. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison). Jul 1986. 215p. (In French). NTIS (US Sales Only), PC A10. Order Number DE88750277/JAW.

The 1973 and 1979 oil crisis have definitely stopped the industrial growth regime based on cheap energy. But since 1960, the decrease of the growing of manufacturing industries and the decrease of the metallurgic sector showed the coming difficulties. In this study it is shown how the energetic strains have induced the restructuration of the U.S. and japanese industries. One of the conclusions is that a major winning card consists in the capacity of organizing the declining sectors as well as the capacity of organizing the promising sectors.

945 **(NSME—8701) Government incentive programs for energy related projects.** (Ontario Hydro, Toronto (Canada). Load Forecasts Dept.). Jan 1987. 31p. (MICROLOG—87-02405). Nova Scotia Dept. of Mines and Energy, Joseph Howe Bldg., P.O. Box 1087, Halifax, Nova Scotia, Canada B3J 2X1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

This report draws together the variety of federal and provincial government programs and initiatives available to those corporations and individuals wishing to undertake an energy-related project in Nova Scotia. These programs and initiatives fall into three basic categories: tax related, related to financial incentives from government, and involving information transfer from government that may be useful to private sector operators. The report is organized in the same manner starting with the various federal ini-

tiatives and running through the provincial sector to joint federal-provincial efforts. The appendix cross-references each program and initiative with the sponsoring department; program contacts and addresses are included. The documentation outlined with each program or initiative describes the program and indicates the incentives available. Various eligibility criteria are provided, although not specified for some programs. Those parties interested in a particular program but unsure whether they fall within the provisions of the program, should contact the sponsoring department for an interpretation, the type of assistance available, and the detailed rules to be followed.

946 **(ORNL—6391) Energy price reform in developing countries: Issues and options.** Hill, L.J. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000981/JAW.

This report discusses options for resolving energy pricing problems in developing countries. Based on a review of the organizational arrangements and commercial energy pricing problems in 37 countries assisted by the US Agency for International Development, economic efficiency criteria, and economic and sociopolitical realities in developing economies, a general program of commercial energy price reform was outlined. Concisely, energy price reform in developing economies is more likely to occur if it takes shape as a balanced, politically realistic set of simultaneous and related actions. The key feature of a reform program is that, because of political considerations, downstream adjustment problems, and income distribution concerns, changes in energy prices to cost-based levels should be a gradual process. Additionally, the adverse effects of changing to cost-based commercial energy prices can be mitigated by implementing measures to reduce the cost of supplying energy, increase the efficiency of energy use, and change organizational arrangements in the commercial energy sector.

947 **(PB—87-210613/XAB) Improving energy data collection and analysis in developing countries: a comparative study in Aganda, Liberia, and Sudan.** Burchfield, S.A. (Agency for International Development, Washington, DC (USA)). Jun 1986. 355p. NTIS, PC A16/MF A01.

This study assesses the resources available for collecting/analyzing data in energy-planning agencies and organizations in Uganda, Liberia, and Sudan. It examines the quality of the national energy assessments and energy supply/demand balance statements conducted, and makes recommendations on training needs, energy planning activities, and data collection/analysis problems. Interviews were conducted with host government and A.I.D. personnel involved in energy-planning activities and projects. Data quality was analyzed using a standardized rating sheet based on recommendations of the U.N. Statistical Commission. The findings identified a number of analytic and institutional problems common to all three countries, and delineated criteria which lead to the success or failure of energy-planning activities.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 106, 227, 228, 302, 333, 359, 361, 362, 392, 431, 670, 894, 910, 972, 1119, 1121, 1122, 1123, 1126, 1127, 1128, 1129, 1130, 1131, 1153, 1154, 1155, 1156, 1157, 1158, 1159, 1706, 1714, 1715, 1716, 1724, 1733, 1758, 1759, 1760, 1797, 1798, 1799, 1809, 1811, 1841, 1991

948 **(AD-A—183127/0/XAB) Installation restoration program. Phase 2. Confirmation/quantification. Stage 1. Volume 2. Final report, October 1984-June 1985.** (Radian Corp., Austin, TX (USA)). Apr 1987. 591p. NTIS, PC A25/MF A01.

See also report dated 6 Mar 87, AD-A180 488.

The purpose of this task is to undertake a field investigation at Sheppard AFB TX to determine the presence or absence of contamination within the specified areas of investigation; if contamination exists, determine the potential for migration of those contaminans in the various environmental media; identify additional investigations necessary to determine the magnitude, extent, direction and rate of migration of discovered contaminants; and identify potential environmental consequences and health risks of migrating pollutants. The Phase I IRP Report incorporates the background and description of the sites for this task.

949 **(NP—8770022) Complexity as an obstacle hindering problem-oriented reactions to forest decline.** Tampe-Oloff, M. (Freiburg Univ. (Germany, F.R.). Forstwissenschaftliche Fakultaet). 1985. 325p. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88770022/JAW.

The forest is the subject of a systemic investigation, including the representation of the ecological fundamentals and state of knowledge in forest damage research. Scientists, social scientists, politicians and interested citizens are to be given insight into the complexity of a man-made ecological crisis, thus contributing to interdisciplinary research and to problem-orientated action on the individual and political field. The dissertation ends with a few suggestions on how social obstacles preventing remedy measures can be overcome.

950 **(PNL—6337) Assessing the benefits of OHER [Office of Health and Environmental Research] research: Three case studies.** Nesse, R.J.; Callaway, J.M.; Englin, J.E.; Klan, M.S.; Nicholls, A.K.; Serot, D.E. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 224p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88000669/JAW.

This research was undertaken to estimate the societal benefits and costs of selected past research performed for the Office of Health and Environmental Research (OHER) of the US Department of Energy (DOE). Three case studies of representative OHER and DOE research were performed. One of these, the acid rain case study, includes research conducted elsewhere in DOE. The other two cases were the OHER marine research program and the development of high-purity germanium that is used in radiation detectors. The acid rain case study looked at the research benefits and costs of furnace sorbent injection and duct injection, technologies that might reduce acid deposition precursors. Both appear to show benefits in excess of costs. We examined in detail one of the OHER marine research program's accomplishments - the increase in environmental information used by the Outer Continental Shelf leasing program to manage bidding for off-shore oil drilling. The results of an econometric model show that environmental information of the type supported by OHER is unequivocally linked to government and industry leasing decisions. The germanium case study indicated that the benefits of germanium radiation detectors were significant.

951 **(UCRL—97278) Sea level changes.** Buddemeier, R.W. (Lawrence Livermore National Lab., CA (USA)). 21 Aug 1987. Contract W-7405-ENG-48. 11p. (CONF-8710150—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014357/JAW.

From CCOP/SOPAC workshop on coastal processes in the South Pacific Island Nations; Lae, Papua New Guinea (5 Oct 1987).

The paper develops an approach to the issues relating to sea level change that will assist the non-scientist and the applied scientist in making the most effective use of our existing and developing knowledge. The human perception of "sea level" and how that changes as societies change and develop are discussed. After some practical perspectives on the relationships between societies and sea levels are developed, an approach to developing the best available local prediction of sea level changes is outlined, and finally present knowledge and uncertainties about the future course of events that will influence "sea level" as defined in the practical sense is discussed.

952 **Beyond the not-in-my-backyard impasse.** Peelle, E.; Ellis, R. (Oak Ridge National Lab., TN). *Forum for Applied Research and Public Policy (Knoxville,Tennessee);* 2: No. 3, 68-77(Fal 1987).

The public acknowledges a need to site and build facilities for hazardous wastes, but the Not-in-my-backyard syndrome prevails. An impasse easily develops between environmentalists and government efforts to identify suitable sites. A sociologist and a waste management expert examine the phenomenon as it has developed in Tennessee. They report the results of interviews which revealed differences between the assumptions and attitudes of local

and state environmental groups. Proximity often turns out to be the key to the degree of opposition to a waste siting proposal. An approach which emphasizes recycling and waste reduction rather than establishing new sites might lead to more productive public participation, while policies based on trade-offs could relieve tensions and encourage public trust. 1 table.

2904 Natural Resources

REFER ALSO TO CITATION(S) 960, 1768

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 3, 10, 48, 122, 147, 154, 195, 533, 1030, 1151, 1994

953 **(AD-A—182404/4/XAB) ONR (Office of Naval Research) Far East Scientific Bulletin. Volume 12, Number 1, January-March 1987.** Wright, G.B.; Kawano, S. (Office of Naval Research Liaison Office, Far East, APO San Francisco 96503). Mar 1987. 120p. NTISMF A01.

Availability: Superintendent of Documents, GPO, Washington, DC 20402 PC $4.50 Microfiche furnished to DTIC (and NTIS) users.

This is a quarterly publication presenting articles covering recent developments in Far Eastern (particularly Japanese) scientific research. Current practice and concepts of superlattice devices are covered. Chinese research efforts in plasma science and technology are discussed. Highlights of the BEAMS '86 Conference and some of the interesting research developments at several Japanese university and industrial laboratories are presented. Some of the papers presented demonstrate Chinese research in high-resolution imaging, electron crystallography, and chemical analysis. Recent research efforts in a number of ceramics-related areas are discussed. The Pohang Institute of Science and Technology has been established to further Korea's commitment to scientific and technological advancement. The physics and control of transitional and turbulent flow processes are discussed at this symposium. Tokamaks, helical systems, and laser fusion research are discussed. Chinese research in superconductive electronics is directed to SQUID magnetometry for biological and geophysical applications and to millimeter and submillimeter wave applications.

954 **(DOE/ER—0345) Advanced energy projects: FY 1987 research summaries.** (USDOE Office of Energy Research, Washington, DC. Advanced Energy Projects Div.). Sep 1987. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000917/JAW.

This report contains brief summaries of all projects active in the Division of Advanced Energy Projects during Fiscal Year 1987 (October 1, 1986-September 30, 1987). The intent of this compilation is to provide a convenient means for quickly acquainting an interested reader with the program in Advanced Energy Projects. More detailed information on research activities in a particular project may be obtained by contacting directly the principal investigator. Some projects will have reached the end of their contract periods by the time this book appears, and will, therefore, no longer be active. Those cases in which work was completed in FY '87 are indicated by the footnote: Project completed. The annual funding level of each project is shown.

955 **(NP—7753272) Bavarian Upper Mining Authority. Annual report 1985.** (Bayerisches Oberbergamt, Muenchen (Germany, F.R.)). 1987. 123p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753272/JAW.

The annual report comprises the following chapters: 1) Developments in the mining industry, 2) Activities of the Bavarian Upper Mining Authority and the regional mining boards, 3) Industrial safety and health protection, 4) Mining technologies and safety, 5) Environmental impact of mining, 6) Special reports on specific subjects.

956 **(NP—7753274) Technical University Hamburg-Harburg, Departments of Water Purification and Environmental Protection. Report 1986.** Foerstner, U.; Sekoulov, I.; Stegmann, R.; Wilderer, P.A. (Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Gewaesserreinigungstechnik; Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik). Feb 1987. 65p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753274/JAW.

Current research projects of Hamburg-Harburg Technical University in the fields of water purification and environmental protection are reviewed. Water treatment comprises bio-aeration and gassing, filtration, phosphate elimination, and heavy metal concentration measurements. In the field of environmental protection, the main activities were in refuse disposal and landfill management.

957 **(NSERC—87) Strategic grants in energy.** (Natural Sciences and Engineering Research Council of Canada, Ottawa, Ontario). 1987. 91p. (In English and French). (MICROLOG—87-03460). Natural Sciences and Engineering Research Council Canada, Communications Division, 200 Kent St., Ottawa, Ont., Canada K1A 1H5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Natural Sciences and Engineering Research Council (NSERC) offers a program of strategic grants to initiate or accelerate research projects in areas of Canadian interest. The program will enable university researchers to make greater contributions than in the past. Eight specific fields were addressed for 1986-1987: biotechnology, communications and computers, energy, environmental toxicology, food and agriculture, industrial materials and processes, oceans, and an open field for other areas of national concern. This document provides summaries of new research projects, a list of ongoing research projects, and summaries of completed projects in the energy field.

958 **(UCRL—15894) The attitudes of science policy, environmental, and utility leaders on US energy issues and fusion.** Miller, J.D. (Northern Illinois Univ., Dekalb (USA). Public Opinion Lab.; Lawrence Livermore National Lab., CA (USA)). 1 Nov 1986. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000784/JAW.

One example of basic and applied research at LLNL that has produced major, highly visible scientific and engineering advances has been the research related to controlled fusion energy. Continuing experimentation at LLNL and elsewhere is likely to demonstrate that fusion is a viable, inexhaustible alternative source of energy. Having conducted major fusion energy experiments for over 30 years at LLNL, it scientists and engineers recognized the enormous challenges that lay ahead in this important endeavor. To be successful, it was clear that collaborative efforts with universities, private industry, and other national laboratories would need to be greatly expanded. Along with invention and scientific discovery would come the challenge of transferring the myriad of new technologies from the laboratories to the private sector for commercialization of the fusion energy process and the application of related technologies to yet unimagined new industries and products. Therefore, using fusion energy research as the focus, the Laboratory's Technology Transfer Initiatives Program contracted with the Public Opinion Laboratory to conduct a survey designed to promote a better understanding of effective technology transfer. As one of the recognized authorities on scientific surveys, Dr. Jon Miller of the POL worked with Laboratory scientists to understand the objectives of the survey. He then formulated the questions, designed the survey, and derived his survey sample from a qualified list developed at the POL, which has formed the basis for other survey panels. This report, prepared by Dr. Miller, describes the basis and methodology of this survey process and then presents the survey findings and some conclusions. 12 refs., 28 tabs.

959 **DHC research program established at Argonne National Laboratory.** *Cogeneration;* 4: No. 2, 22-23(May-Jun 1987).

The Argonne research program on district heating and cooling (DHC) focuses on three principal areas: advanced energy transmission fluids, component development, and institutional studies. Key objectives in the three areas are to improve DHC thermal-hydraulic performance, operating costs, and capital costs; develop thermoplastic pipe materials capable of handling temperatures of 250 F and above; and development of model statutes to remove state and local regulatory impediments to DHC programs. Industrial collaborators contribute to the national laboratory programs.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 276, 301, 304, 333, 359, 392, 404, 405, 748, 839, 972

960 **(DOE/EIA—0478(86)) Uranium industry annual, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 9 Oct 1987. 144p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88001442/JAW.

Uranium industry data collected in the EIA-858 survey provide a comprehensive statistical characterization of annual activities of the industry and include some information about industry plans over the next several years. This report consists of two major sections. The first addresses uranium raw materials activities and covers the following topics: exploration activities and expenditures, resources and reserves, mine production of uranium, production of uranium concentrate, and industry employment. The second major section is concerned with the following uranium marketing activities: uranium purchase commitments, uranium prices, procurement arrangements, uranium imports and exports, enrichment services, inventories, secondary market activities utility market requirements and related topics.

961 **(INIS-mf—10989) Selection of sites for nuclear power plants in the Netherlands. Pt. B. Headlines from the participation of the Dutch people.** (Raad van Advies voor de Ruimtelijke Ordening, The Hague (Netherlands)). 17 Jan 1986. 44p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703575/JAW.

In this report the headlines are presented of the participation of the Dutch people in the policy resolution with regard to the selection of sites of nuclear power plants. In Ch. 1 it is indicated how this participation is organized and the quantitative results are given. In the other chapters the results of the people's participation are treated qualitatively with restriction to the headlines. In Ch. 3 the remarks about the procedure and its precedents are reported. Ch. 4 reflects the public opinion with regard to the (nuclear) energy problem. In Ch. 5 finally the problems concerning the sites of nuclear power plants are treated. The criteria are discussed used by the participants in the judgement of the locations on their aptitude, in general as well as by possible site. (Auth.). Tweede Kamer, vergaderjaar 1985-1986, 18830, nrs. 41-42; 9 refs.; 2 figs.; 1 table.

962 **(INIS-mf—10993) Dutch nuclear power and the environmental implications of uranium mining and milling. An analysis in the framework of energy policy formulation.** Thornton, S.J. (Stuurgroep-World Conservation Strategy (Netherlands)). Apr 1986. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703761/JAW.

This report is aimed at furthering the understanding of some of the international impacts of Dutch nuclear power generation. It has two principle objectives: 1. To clarify the connection between nuclear power generation in the Netherlands and environmental degradation elsewhere as a result of the mining and milling of uranium. 2. To establish the relevance of this environmental degradation to the formulation of Dutch energy policy. (Auth.). Contains a selected bibliography of 92 refs.; 14 figs.; 5 tabs.

963 **(INIS-mf—10995) [Argentina Nuclear Program]. Annual report 1984.** (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1986. 48p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703763/JAW.

Advances and achievements of the Argentine Nuclear Program during 1984 are distributed into the following sections: Nuclear Power Plants, Supplies to Nuclear Power Plants, Radioisotopes and Radiations, Radiological Protection and Nuclear Safety, Research and Development, and Infraestructure and General Aspects. (M.E.L.).

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 959, 1132

964 **(PB—87-220166/XAB) Electricity and cogeneration systems planning: how much cogeneration is enough. Research report.** Kwun, Y.; Baughman, M.L. (Texas Univ., Austin (USA). Center for Energy Studies). Feb 1987. 49p. (CES—17). NTIS, PC A03/MF A01.

A model is presented that integrates the supply planning of potential cogenerating industries with that of the host electric-utility suppliers. It provides both electric-utility and cogeneration optimal supply plans under the technical and economic relationships that link the two sectors. In addition, it provides a tool for public policy makers to analyze the effects of important public-policy instruments on the growth and development of cogeneration. How much the potential benefits of cogeneration might be, how much of the potential might be realized, and how the benefits might be distributed among industrial users and the purchasing electric utilities and their consumers are the topics addressed.

2910 Conservation

REFER ALSO TO CITATION(S) 1025, 1062, 1101, 1102, 1103

965 **(LBL—23926) Evaluation of the implementation of home energy rating systems.** Vine, E.; Barnes, B.K.; Ritschard, R. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 16p. (CONF-870811—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000470/JAW.

From Energy conservation program evaluation: practical methods and useful results; Chicago, IL, USA (19 Aug 1987).

We evaluate the implementation of home energy rating and labelling programs (HERS) that are being conducted around the country. We examine the nature of different implementation problems and the kinds of strategies that have been used to deal with them to ensure the effective penetration of HERS to all HERS users. We use a model of the implementation process that assumes implementation is strongly influenced by the local context, involves two-way communication, and assumes little commonality of purpose among participants, saving a consensus on reaching some sort of decision.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 197, 200, 216, 359, 460, 542, 1003, 1010, 1025

966 **(ERP/MSL—8701) Energy in Canada. An overview. Discussion paper.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Jan 1987. 32p. (MICROLOG—87-02687). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1. PC $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This paper provides a broad perspective on energy issues by reviewing the critical characteristics of Canada's energy system and considering the role of governments in responding to current challenges and problems. The energy system is discussed with regard to resource potential, economic importance, consumption and production, energy trade and its changing role. Problems of economic restructuring, energy efficiency, security, trade, technological and environmental concerns are addressed. Historical and current roles of the Canadian government involvement are reviewed with a forecast for possible future participation. 15 figs.

967 **(NP—7753267) Sudan - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). May 1987. 17p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753267/JAW.

The energy situation of Sudan is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures, are presented on the country's external trade and balance of payments.

968 **(NP—7753269) Tunisia - energy situation 1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). May 1987. 11p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753269/JAW.

The energy situation of Tunisia is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources. Key figures are presented on the country's external trade.

969 **(NP—7753275) Malaysia - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). May 1987. 13p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753275/JAW.

The energy situation of Malaysia is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in energy sources and electric power generation.

970 **(OME—870130/1) Energy security for Canada. Expanding energy supplies.** (Ontario Ministry of Energy, Toronto (Canada)). Jan 1987. 15p. (MICROLOG—87-04048). Ontario Ministry of Energy, 56 Wellesley St. W., 12th Floor, Toronto, Ontario, Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

This paper focuses on the question of securing future supplies of energy, particularly crude oil and natural gas. Security can be enhanced by conservation and efficient use, substitution of more plentiful energy forms, development of renewable sources, contingency planning for an international oil supply shortfall possibility, and export policies to ensure sufficient reserves. A framework for ensuring a domestic supply capability is proposed. 3 figs., 4 tabs.

971 **The LBL residential energy and hourly demand models.** McMahon, J.E.; Chan, P.; Eto, J.; Koomey, J.; Levine, M.; Pignone, C.; Ruderman, H. (Lawrence Berkeley Lab., CA, USA). pp 205-212 of Strategic planning in energy and natural resources. Lev, B. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (North-Holland) (1987). (CONF-8604185—). Contract AC03-76SF00098.

From 2. symposium on analytic techniques for energy, natural resources, and environmental planning; Philadelphia, PA, USA (3 Apr 1986).

To forecast utility's electricity sales and hourly demands by end-use, Lawrence Berkeley Laboratory (LBL), University of California, developed two models: LBL residential energy model and LBL residential hourly and peak demand model. They provide forecasts of energy consumption and hourly demands by end-use. These models have been applied to five electric utility service areas. Reasonable agreement with historical residential sales (within 5%) and hourly demands (within 15% on peak) was obtained over several years of data. These models offer: end-use economic response (fuel choice and usage); end-use engineering detail; separation of customers into rate classes; integration of residential sales and hourly demand projections; and capability to analyze demand-side impacts.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 120, 188, 189, 200, 201, 232, 233, 234, 235, 246, 397, 405, 940, 962, 963, 1062, 1758, 1991

972 **(DOE/RW—0144) Office of Civilian Radioactive Waste Management: Annual report to Congress.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Apr 1987. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87010329/JAW.

This document summarizes the activities of the Office of Civilian Radioactive Waste Management for FY 1986. Topics include public interaction between the states and affected Indian Tribes, planning for a waste management system, site selection and site characterization of potential geologic repositories, participation in international repository projects, proposal development for a monitored retrievable storage system, demonstrations of spent fuel storage, and development of quality assurance and safety plans. 59 refs., 10 figs., 6 tabs. (TEM)

973 **(NP—7770288) Uruguay - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Nov 1986. 18p. (In German). NTIS (US Sales Only), PC A02. Order Number DE87770288/JAW.

The energy situation of Uruguay is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

974 **(NP—7770289) Portugal - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Nov 1986. 28p. (In German). NTIS (US Sales Only), PC A03. Order Number DE87770289/JAW.

The energy situation of Portugal is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

975 **(NP—7770290) Somalia - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Dec 1986. 12p. (In German). NTIS (US Sales Only), PC A02. Order Number DE87770290/JAW.

The energy situation of Somalia is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade.

976 **(NP—7770291) Tunisia - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Dec 1986. 13p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770291/JAW.

The energy situation of Tunisia is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

977 **(NP—7770292) Spain - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 59p. (In German). NTIS (US Sales Only), PC A04. Order Number DE87770292/JAW.

The energy situation of Spain is reviewed in detail on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

978 (NP—7770295) **Sweden - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 27p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87770295/JAW.

The energy situation of Sweden is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

979 (NP—7770296) **Argentina - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 27p. (In German). NTIS (US Sales Only), PC A03. Order Number DE87770296/JAW.

The energy situation of Argentina is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation.

980 (NP—7770297) **Oman - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Mar 1987. 16p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770297/JAW.

The energy situation of Oman is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

981 (NP—7770298) **Great Britain - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Feb 1987. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87770298/JAW.

The energy situation of Great Britain is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

982 (NP—7770299) **Australia - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Mar 1987. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87770299/JAW.

The energy situation of Australia is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

983 (NP—7770300) **Austria - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 25p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770300/JAW.

The energy situation of Austria is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

984 (NP—7770301) **Costa Rica - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Oct 1986. 8p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770301/JAW.

The energy situation of Costa Rica is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

985 (NP—7770302) **Senegal - energy situation 1984/1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Oct 1986. 20p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770302/JAW.

The energy situation of Senegal is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

986 (NP—7770303) **Egypt - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 20p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770303/JAW.

The energy situation of Egypt is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

987 (NP—7770304) **Morocco - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Oct 1986. 18p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770304/JAW.

BfAI-Marktinformation. Reihe MI-BS.; No. 29.518.86.252.

The energy situation of Morocco is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

988 (NP—7770305) **United Arab Emirates - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Mar 1987. 12p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770305/JAW.

The energy situation of the United Arabian Emirates is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in energy sources. Key figures are presented on the country's external trade.

989 (NP—7770307) **Kuwait - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Feb 1987. 18p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770307/JAW.

The energy situation of Kuwait is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

990 (NP—7770308) **New Zealand - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87770308/JAW.

The energy situation of New Zealand is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

991 (NP—7770309) **Burma - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 24p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770309/JAW.

The energy situation of Burma is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy

sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

992 **(NP—7770312) South Africa - energy situation 1984/1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Oct 1986. 26p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87770312/JAW.

The energy situation of South Africa is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

993 **(NP—7770314) Ethiopia - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Oct 1986. 10p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770314/JAW.

The energy situation of Ethiopia is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

994 **(NP—7770315) Guinea - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Oct 1986. 8p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770315/JAW.

The energy situation of Guinea is reviewed on the basis of relevant data. Data on the country's national energy policy are followed by an outline of trends in petroleum and electric power generation.

995 **(NP—7770316) Togo - energy situation 1985.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Oct 1986. 18p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770316/JAW.

The energy situation of Togo is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

996 **(ORNL—6361) Final evaluation of USAID [US Agency for International Development] Alternative Energy Sources Project in Ecuador (Project No. 518-0029/Loan No. 518-W-039).** Maestas, G.; Jones, D.W.; Samuels, G. Jr.; Younger, D.R. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88000983/JAW.

This evaluation concentrated on reviewing the project's original purpose and design; modifications to the design over the project's life; the project's accomplishments and shortcomings; and the record of the project's implementation from the completion of the project's mid-term evaluation in April-May 1984 through June 1986. Goals were to encourage more rational use of energy resources in order to improve Ecuador's ability to meet the energy needs of its population [and] to better address the energy needs of lower income Ecuadorian families, particularly those in rural areas. To achieve these goals, the project was to strengthen INE's [the National Energy Institute, Instituto Nacional de Energia] institutional capacity to affect overall GOE [government of Ecuador] energy planning and the promotion of NCE (nonconventional energy) technologies appropriate to Ecuador.

997 **Using the PILOT model to study the effects of technological change.** Stone, J.C.; McAllister, P.H.; Dantzig, G.B. (Stanford Univ., CA, USA). pp 31-42 of Strategic planning in energy and natural resources. Lev, B. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (North-Holland) (1987). (CONF-8604185—).

From 2. symposium on analytic techniques for energy, natural resources, and environmental planning; Philadelphia, PA, USA (3 Apr 1986).

PILOT is a large-scale dynamic model of the U.S. economy which synthesizes structural representations of all sectors of the economy in a general equilibrium context. PILOT's process-oriented representation of production syntheaizes engineering-type data (or judgments) about sector-specific technological alternatives into a consistent overall picture of the long-run consequences of technological change and of government policy and foreign market conditions in the context of technological change. Ongoing studies focus on the effects of a 'high-tech' (vs. a 'low-tech') economy on aggregate and sectoral patterns of growth, employment, and energy use over the next 25 years. 3 refs., 2 tabs.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 3, 10, 15, 48, 106, 120, 122, 122, 147, 154, 188, 189, 195, 197, 199, 206, 206, 216, 218, 246, 250, 941, 944

998 **(Juel-Spez—389) Adaption of the crude oil refining industry in the Federal Republic of Germany to future demand patterns of the year 2000 - a model-assisted analysis.** Mueller, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung; Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.)). Feb 1987. 208p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750425/JAW.

Forecasts expect significant structural changes of the domestic oil market in the Federal Republic of Germany up to the end of this century. This raises the issue of an adequate adaptation of the German refining industry which is discussed in this report. For a concise analysis of the expected adaptation processes, an aggregated model of domestic crude oil refining is developed. It contains a detailed description of the relevant refinery processes and incorporates the price determining effects of the international oil markets. The model is applied to quantify adaptation strategies for the German refining industry, taking into account the quantitative aspects of future oil demand patterns as well as the qualitative implications of stronger environmental controls on crude oil processing and oil product specifications.

999 **(LA-UR—87-2664) The use of industrial energy in seven OECD [Organization for Economic Cooperation and Development] countries.** Sutherland, R.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 13p. (CONF-870710—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014733/JAW.

From International Association of Energy Economists conference; Calgary, Canada (6 Jul 1987).

The objective of this study was to analyze the industrial demand for energy in seven Organization for Economic Cooperation and Development (OECD) countries with particular emphasis on fuel substitution between oil, natural gas, coal, and electricity. Changing fuel demand also results from economic growth, changes in industrial structure, and changes in the energy intensity of industrial output. A historical analysis of these factors and fuel substitution is undertaken for industry as an aggregate, and for 12 specific industries. The major results of the historical analysis are: (1) fuel use changes are a result of fuel switching, changing energy intensity, changing industrial structure, and economic growth; (2) fuel substitutability depends upon fuel use. The three fossil fuels are substitutes in the industrial heat market, but there are numerous special industrial processes where a particular fuel is required; (3) large substitutions have occurred between fuels; (4) fuel substitutions have been very different across countries, both in the type of substitutions that have occurred and the factors accounting for the substitutions; and (5) in most countries, major changes in fuel use can be explained by two or three industries, suggesting that future analyses be industry specific.

1000 **(NP—7770274) Economic aspects and resource aspects of the use of coal in the Federal Republic of Germany in the year 2000. Final report. Period covered: April 1, 1981 to June 30, 1983.** Jochem, E.; Boehm, E.; Garnreiter, F.; Herz, H.; Legler, H.; Mannsbart, W.; Mielicke, U. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung). 1987. 181p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87770274/JAW.

The study abstracted analyses the future chances of coal as an energy source supplying energy for space heating and tap water heating, the production of fuels and chemical feedstocks all of which do at present depend almost exclusively on the availability of imported petroleum and natural gas. The study aimed at developing a calculation vehicle which in a quantitative way would assess the priorities of coal uses or coal substitution, respectively, within the different fields of application according to economic criteria. A procss-analytical linear optimization model was developed in order to describe the different feasible ways of substitution within the conversion system. Due to the fact that instead of on thetemporal realization emphasis was on the realization of an economically optimal structure the choice of the year 2000 as a reference year justifies the use of a static model. The optimization model applied allows the technological and economic simulation of the different ways of obtaining end products from energy sources.

1001 **(NP—7770275) Petroleum and the OPEC.** (Deutsche Shell A.G., Hamburg (Germany, F.R.). Abt. Information und Presse). Jul 1986. 15p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770275/JAW.

Within the chain of events which since the remarkable rise in petroleum prices in 1973 have been causing considerable changes on the energy market of the world the severe slump of petroleum prices at the beginning of 1986 is the latest one. The Shell Briefing Service discusses these changes in view of economic developments, the consequences implied with respect to petroleum demands and the changing successes of the OPEC as an oil extraction and export organization.

1002 **(NP—7770306) Brazil - energy situation 1985/1986.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jan 1987. 19p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87770306/JAW.

The energy situation of Brazil is reviewed on the basis of relevant data. Data on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Key figures are presented on the country's external trade and balance of payments.

1003 **SIMBID: An alternative, simplified model of bidding and awarding of new natural gas reserves.** Kydes, A.S.; Wing, J. (Energy - Economic Systems Analysis Div., Brookhaven National Lab.). pp 383-388 of Energy markets in the longer-term: Planning under uncertainty. Kydes, A.S.; Geraghty, D.M. New York, NY; Elsevier Science Pub. Co. Inc. (1985). (CONF-840851—).

From 2. IMACS symposium on energy modeling and simulation; Upton, NY, USA (26 Aug 1984).

The main purpose of this paper is to provide an overview of the SIMBID methodology which develops demands for new natural gas reserves- one possible alternative to the dynamic programming formulation incorporated in the Gas Analysis Modeling System (GAMS). The demand curves are derived for each pipeline system based on, among other things, the "expected" price of the principal competing fuel for each pipeline system, the "expected" demand in the next few years for each pipeline system, the deliverability for the pipeline's controlled gas reserves and other contractual obligations. Several illustrations of the SIMBID model behavior within GAMS are also provided. SIMBID has produced results similar to the current model, using the same set of exogenous assumptions, with a more than 50% reduction in computer time for the bidding component of GAMS. This is due to the simplification of the SIMBID algorithm and reduced demands on other components of the GAMS.

2960 Electric Power

REFER ALSO TO CITATION(S) 188, 189, 462, 463, 464, 670, 673, 971, 999, 1133, 1134

1004 **(DOE/BP—827, pp 17-19) Competitive Pacific Coast Energy Markets Panel.** Apr 1987. NTIS, PC A06/MF A01. Order Number DE87009112/JAW.

In Third annual Bonneville Power Administration/State of Washington informational meeting: Vance Tyee Motor Inn, Tumwater, Washington, October 22, 1986.

A panel discussion between representatives of Northwest Power Planning Commission, Bonneville Power Administration, energy consultants, and local water and power systems explored various perceptions of the competitive West Coast energy markets. Among the topics were arrangements between the Northwest region and Southern California to market power and water resources, the factors which affect power sales, and the roles of each of the institutions. The legal aspects of interconnected power systems which have different voltage levels, price differentials between regions, and the large investments made to develop alternative energy sources have affected the competitive markets. The report includes a talk by each of the participants, comments by the moderator, and a brief discussion.

1005 **(DOE/EIA—0226(87/07)) Electric power monthly, July 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 9 Oct 1987. 47p. NTIS, PC A03 - GPO. Order Number DE88001443/JAW.

Total net generation by electric utilities in the United States reached a record high in July 1987, 247,461 gigawatthours. The previous 1-month net generation record occurred in July 1986 when electric utilities generated 242,672 gigawatthours of electricity. The record-setting level of net generation from coal, 143,503 gigawatthours, reached in July 1987, was 5% higher than in July 1986. In addition, net generation from nuclear-powered units reached 39,603 gigawatthours in July 1987. This was the second-highest level of nuclear energy, surpassed only by the January 1987 level of 39,975 gigawatthours. 27 tabs.

1006 **(EPRI-EA—5433) Operational procedures to evaluate decisions with multiple objectives: Final report.** Keeney, R.L.; von Winterfeldt, D. (University of Southern California, Los Angeles (USA). Inst. of Safety and Systems Management; Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 161p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920030/JAW.

The purpose of this workbook is to make the knowledge of procedures for structuring and quantifying objectives available and useful to analysts and decision makers in the utility industry. Using many examples, the workbook explains how to structure objectives in the form of an objectives hierarchy, how to develop scales that operationalize these objectives, how to construct a quantitative objective function to evaluate alternatives, and how to use such an analysis in the context of decision problems faced by the utility industry today. 86 refs., 25 figs., 17 tabs.

1007 **(EPRI-EM—5457) DSM [Demand-Side Management] technology alternatives: Interim report.** Blevins, R.P.; Kirksey, W.E.; Miller, B.A.; Skelton, J.C.; Khosla, N.K. (Battelle Columbus Div., OH (USA); Enviro-Management and Research, Inc., Springfield, VA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 261p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920049/JAW.

This report contains information on demand-side management technology alternatives applicable to the residential, commercial, industrial, and agricultural sectors. Descriptive information on operating characteristics, applicability, specifications, and customer and utility benefits is provided in a standardized Technical Brief format for 99 technologies. Matrices are included to guide the reader in the intuitive application and use of the information contained in the Technical Briefs. 24 figs.

1008 **(NEB-SS—870501) Reasons for decision in the matter of an application under the National Energy Board Act of Hydro-Quebec for exports to the New England Utilities.** (National Energy Board, Ottawa, Ontario (Canada)). May 1987. 22p. (In English and French). (EH—1-87). National Energy Board, Regulatory Support Office, 473 Alberta Street, Ottawa, Ontario, Canada K1A 0E5; $N/C.

The National Energy Board denied an application by Hydro-Quebec for a licence to export electric energy to utilities in the New England States. Hydro-Quebec had applied to the Board for a licence authorizing the export of 70 billion kilowatt hours of firm energy over a period of up to 14 years beginning in 1990. The Board stated that evidence presented by Hydro-Quebec was insufficient to demonstrate that energy proposed to be exported was surplus to foreseeable Canadian requirements for use in Canada, and that export price was not less than the price to Canadians for equivalent service in related areas. A utility requesting an export licence is required under the National Energy Board Act and regulations to furnish this information. To comply, it has been normal practice for utilities proposing to export electricity to first offer this electricity to neighboring provinces at a price less than the export price for comparable service. Refusals of such offers have been taken by the Board as an indication that Canadian utilities do not require the electricity proposed to be exported. Hydro-Quebec failed to make such offers to its neighboring utilities in Ontario, New Brunswick and Newfoundland, and did not provide any other evidence sufficient to satisfy the Board that the energy proposed to be exported was surplus to Canadian needs and that the price was reasonable in relation to the public interest. The Board's report provides details on the Board's requirements, findings, and reasons for decision, and outlines Hydro-Quebec's position, as well as the views of interested parties who took part in the hearing.

1009 **(PEIPUB—870430) In the matter of the Public Utilities Commission Act and the Electric Power and Telephone Act and in the matter of the application of Maritime Electric Company, Limited for approval of the disposition of excess revenue. Order.** (Prince Edward Island Public Utilities Commission, Charlottetown (Canada)). 30 Apr 1987. 3p. Prince Edward Island Public Utilities Commission, 134 Kent St., PO Box 577, Confederation Court Bldg., Ste. 501, Charlottetown, Prince Edward Island, Canada C1A 7L1; $N/C.

Order was given to the Maritime Electric Company, Limited by the Public Utilities Commission to return excess revenue from 1986, with interest, to its customers as credit for May, June, July, and August 1987 and not to be included as a twelve month moving average. Also, data confirming actual figures are to be submitted.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 971, 999

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 455, 460, 520, 533, 1024

1010 **Optimizing solar energy systems under uncertainty.** Leigh, R.W. (Dept. of Applied Science, Brookhaven National Lab., Upton, NY 11973). pp 173-178 of Energy markets in the longer-term: Planning under uncertainty. Kydes, A.S.; Geraghty, D.M. New York, NY; Elsevier Science Pub. Co. Inc. (1985). (CONF-840851—). Contract AC02-76CH00016.

From 2. IMACS symposium on energy modeling and simulation; Upton, NY, USA (26 Aug 1984).

The technical and economic characteristics of optimized solar energy systems can be expressed in a concise mathematical expression and this expression manipulated to show the dependence of total system cost on variables such as collector cost and efficiency, weather data or the cost of backup fuel. The lack of certain knowledge of future weather, fuel prices and system performance implies that a system optimized with respect to an assumed set of these data may not be optimal with respect to the realities of operation. The author shows how the life cycle costs of the system increase as a result of errors in estimating various system parameters; in most cases, the costs of errors are not large over their expected ranges, and, more importantly, in the face of unavoidable uncertainty, it is best to error on the side of overcapitalization.

30 DIRECT ENERGY CONVERSION

1011 **(PB—87-216024/XAB) Bulletin of Research Institute for Polymers and Textiles, No. 153, 1986-11.** (Research Inst. for Polymers and Textiles, Yatabe, Ibaraki (Japan)). 1986. 96p. NTIS, PC E04/MF E01.

Text in Japanese with English abstracts. See also PB—87-216032 and PB—87-146031.

Energy conversion is one of the essential functions of living organisms and the function has been shown to be extremely elaborate and of high efficiency. The development of new technology to get useful energy from any kind of sources is currently the most-important problem of the world. The problem could be divided into two; the one is the exploration of new energy sources and the other is the new energy-conversion systems with high efficiency. Studies of mimicking biological energy conversion are new trends in the research on the energy problem. The report shows some of the results of the research project, biomimetic energy conversion, which was carried out from 1979 through 1985 in this Institute. The project dealt mainly with artificial photosynthesis: (1) solar cells using natural and synthetic dye molecules; (2) hydrogen production by water photolysis; (3) other energy-conversion systems related to biopolymers such as photochemical energy conversion by bacteriorhodopsin and mechanochemical energy conversion by tubulin-microtubule system.

3001 Mhd Generators

1012 **(AD-A—183323/5/XAB) Plasma theory and simulation. Quarterly progress report Nos. 1 and 2, 1 January-30 June 1986.** Birdsall, C.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 30 Jun 1986. 27p. NTIS, PC A03/MF A01.

Computer simulation of bounded plasma systems, with external circuits, is discussed in considerable detail; artificial cooling of trapped electrons in bounded simulations was observed and is now attributed to noiseless injection: the cooling does not occur if random injection is used; the collector and source sheaths at the boundaries of warm plasma are treated in detail, including ion reflection and secondary-electron emission at the collector; the kelvin-Helmholtz instability is observed in a self-consistent magnetized sheath, producing long-lived vortices which increase the particle transport to the wall dramatically; the ES2 user's manual - Version 1 has been issued; addition of electron-neutral elastic collisions is introduced; implicit particle simulation of velocity space transport and self-consistent electric potentials in magnetized plasmas (TESS code) is described in detail; and dynamic dimensioning with heap management is described in detail.

1013 **(EUT-EG—86-395.1) Methods and results of diagnosis in a closed-cycle MHD blow down generator.** Van Veldhuizen, E.M.; Flinsenberg, H.J. (Technische Hogeschool Eindhoven (Netherlands)). Nov 1986. 40p. Eindhoven Univ. of Technology, P.O. Box 513, 5600 MB Eindhoven, Netherlands.

After many years of experimenting with the 5 MW-thermal blow down generator much knowledge has been gained about its construction and operation. Measurements are described for obtaining useful information about the system. The most important parameters that have been determined are the density and size of dust particles, the density of impurities, seed ratio, electron temperature and density, streamer velocity and pressure. The maximum power output that has been reached is 423 kW with an enthalpy extraction of 8.5%. The most important functional conclusions that can be drawn about the generator are: the hot flow train inside the magnet should not contain any metal components, except for the electrodes, because shortcircuiting gives a great increase in the exit pressure; water contamination should be reduced to less than 100 ppm; and, the load resistors must have a low inductance in order to

provide good ignition conditions for the streamers. 10 figs., 2 tabs., 18 refs.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 214, 554

1014 **(AD-A—182963/9/XAB) Photoluminescent properties of p-GaAs electrodes related to the photocurrent anomaly: determination of surface electron-capture velocities and depletion widths in photoelectrochemical cells. Technical report.** Johnson, P.B.; McMillan, C.S.; Ellis, A.B.; Hobson, W.S. (Wisconsin Univ., Madison (USA). Dept. of Chemistry). 8 Jul 1987. 28p. (UWIS/DC/TR—87/4). NTIS, PC A03/MF A01.

Steady-state photoluminescence (PL) measurements have been used to determine depletion widths W and surface electron-capture velocities S for p-GaAs electrodes in aqueous acidic electrolytes. Electrodes subjected to slow cycling of applied potential (10 mV/s) exhibit a hysteresis in PL intensity in the photocurrent anomaly (PA) potential regime, characterized by negligible photocurrent at voltages up to approx. 0.5 V negative of the flatband potential approx. 0.1 V vs. SCE). A marked hysteresis in S values is observed in the PA potential regime of -0.1 to -0.4 V vs. SCE. Estimated S values are high, approaching 10^7 cm/s, but decrease significantly during anodic-going scans. Variations in W between -0.1 and -0.8 V vs. SCE indicate that strong Fermi-level pinning does not obtain. Electrode operation under a pulsed potential program (-0.05 to -1.00 V vs. SCE) caused a transient reduction in S of approximately an order of magnitude.

1015 **(AD-A—183026/4/XAB) Effect of physical and geometric factors on the impedance of electrochemical power sources. Interim report.** Cahan, B.D.; Daroux, M.L.; Yeager, E.B. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Physics). 1 May 1987. 27p. (TR—1). NTIS, PC A03/MF A01.

Short-time transient behavior in the charge/discharge of small electrochemical power sources does not scale up for large systems. Calculations presented show that a number of commonly neglected physical and geometric factors, such as the skin effect and the distributed network impedance characteristics of the individual cells and cell assemblies, can severely limit performance. The impedance of individual cells has been calculated over a wide range of frequencies 100 to 10^8 Hz) using a modified semi-infinite strip-line model. The variables considered include the electrode and electrolyte conductivities, the electrolyte dielectric constant, the double-layer capacitance, and the distributed inductance and capacitance resulting from the cell geometry.

1016 **(ECN—87-125) Micromodelling of processes in molten carbonate fuel cells.** Janssen, G.J. (Netherlands Energy Research Foundation, Petten). Aug 1987. 5p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

An outline is given of proposed computational studies on the properties of the carbonate melt and ions dissolved in it. Modern computational methods such as Molecular Dynamics and Monte Carlo are very powerful tools in the study of complex, disordered systems such as melts at a high temperature. 5 refs.

1017 **(PB—87-221255/XAB) Characterization of instrumented sites for Onsite Fuel-Cell Field-Test project. Volume 3. Topical report, 1983-1985.** Racine, W.C.; Campillo, C.J. (Science Applications International Corp., La Jolla, CA (USA)). Nov 1986. 569p. (SAIC—86/1929-VOL-3). NTIS, PC A24/MF A01.

See also Volume 2, PB—87-221248, and Volume 4, PB—87-221263; Also available in set of 6 reports PC E99, PB—87-221222.

During the site-selection phase of the Onsite Fuel-Cell Field Test, nearly one hundred sites throughout the U.S. were each instrumented with a standard data-acquisition system (DAS) to collect hourly electrical and thermal data for one year. Seventy of those sites are included in the report. Each site's electrical and thermal systems were instrumented including ambient temperature, electrical demands, building gas usage, and other parameters necessary to calculate building thermal loads. Multifamily residential, commercial, and light industrial sites were instrumented. Approximately twenty market sectors were represented including restaurants, hospitals, hotels, apartments, health clubs, nursing homes, and food processing plants. The primary use of the data was to determine site compatibility for the installation of 40-kW fuel-cell power plants. However, the collected energy data and site-specific information summarized in this comprehensive report may also be useful for other applications such as market characterization and simulation of new or improved energy-utilization equipment in actual sites. This volume focuses on hotels, laundries, and restaurants.

1018 **(PB—87-221263/XAB) Characterization of instrumented sites for the onsite fuel-cell field-test project. Volume 4. Topical report, 1983-1985.** Racine, W.C.; Campillo, C.J. (Science Applications International Corp., La Jolla, CA (USA)). Nov 1986. 518p. (SAIC—86/1929-VOL-4). NTIS, PC A22/MF A01.

See also Volume 3, PB—87-221255, and Volume 5, PB—87-221271; Also available in set of 6 reports PC E99, PB—87-221222.

During the site-selection phase of the Onsite Fuel-Cell Field Test, nearly one hundred sites throughout the U.S. were each instrumented with a standard data-acquisition system (DAS) to collect hourly electrical and thermal data for one year. Seventy of those sites are included in the report. Each site's electrical and thermal systems were instrumented including ambient temperature, electrical demands, building gas usage, and other parameters necessary to calculate building thermal loads. Multifamily residential, commercial, and light industrial sites were instrumented. Approximately twenty market sectors were represented including restaurants, hospitals, hotels, apartments, health clubs, nursing homes, and food-processing plants. The primary use of the data was to determine site compatibility for the installation of 40-kW fuel-cell power plants. However, the collected energy data and site-specific information summarized in this comprehensive report may also be useful for other applications such as market characterization and simulation of new or improved energy-utilization equipment in actual sites. This volume covers metal-plating facilities, nurseries, nursing homes, office buildings and other industrial applications.

1019 **(PB—87-221271/XAB) Characterization of instrumented sites for the onsite fuel-cell field-test project. Volume 5. Topical report, 1983-1985.** Racine, W.C.; Campillo, C.J. (Science Applications International Corp., La Jolla, CA (USA)). Nov 1986. 575p. (SAIC—86/1929-VOL-5). NTIS, PC A24/MF A01.

See also Volume 4, PB—87-221263, and Executive Summary, PB—87-221289; Also available in set of 6 reports PC E99, PB—87-221222.

During the site-selection phase of the Onsite Fuel-Cell Field Test, nearly one hundred sites throughout the U.S. were each instrumented with a standard data-acquisition system (DAS) to collect hourly electrical and thermal data for one year. Seventy of those sites are included in the report. Each site's electrical and thermal systems were instrumented including ambient temperature, electrical demands, building gas usage, and other parameters necessary to calculate building thermal loads. Multifamily residential, commercial, and light industrial sites were instrumented. Approximately twenty market sectors were represented including restaurants, hospitals, hotels, apartments, health clubs, nursing homes, and food-processing plants. The primary use of the data was to determine site compatibility for the installation of 40-kW fuel-cell power plants. However, the collected energy data and site-specific information summarized in the comprehensive report may also be useful for other applications such as market characterization and simulation of new or improved energy-utilization equipment in actual sites. This volume focuses on photographic laboratories, restaurants, schools, telephone communications, trucking terminals, and water-processing plants.

1020 **Electrode assembly for use in a solid polymer electrolyte fuel cell.** Raistrick, I.D. (to Dept. of Energy). US Patent Application 6-009,843. 30 Jan 1987. 16p. Contract W-7405-ENG-36. DE88000862 NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000862/JAW.

A gas reaction fuel cell may be provided with a solid polymer electrolyte membrane. Porous gas diffusion electrodes are formed of carbon particles supporting a catalyst which is effective to enhance the gas reactions. The carbon particles define interstitial spaces exposing the catalyst on a large surface area of the carbon particles. A proton-conducting material, such as a perfluorocarbon copolymer or ruthenium dioxide, contacts the surface areas of the carbon particles adjacent the interstitial spaces. The proton-conducting material enables protons produced by the gas reactions adjacent the supported catalyst to have a conductive path with the electrolyte membrane. The carbon particles provide a conductive path for electrons. A suitable electrode may be formed by dispersing a solution containing a proton-conducting material over the surface of the electrode in a manner effective to coat carbon surfaces adjacent the interstitial spaces without impeding gas flow into the interstitial spaces.

1021 **Sintering aid for lanthanum chromite refractories.** Flandermeyer, B.K.; Poeppel, R.B.; Dusek, J.T.; Anderson, H.U. (to Dept. of Energy). US Patent Application 6-922,429. 23 Oct 1986. 19p. Contract W-31109-ENG-38. DE88000837 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000837/JAW.

An electronically conductive interconnect layer for use in a fuel cell or other electrolytic device is formed with sintering additives to permit densification in a monolithic structure with the electrode materials. Additions, including an oxide of boron and a eutectic forming composition of Group 2A metal fluorides with Group 3B metal fluorides and Group 2A metal oxides with Group 6B metal oxides, lower the required firing temperature of lanthanum chromite to permit densification to in excess of 94% of theoretical density without degradation of electrode material lamina. The monolithic structure is formed by tape casting thin layers of electrode, interconnect and electrolyte materials and sintering the green lamina together under common densification conditions.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 957, 966

1022 **(DOE/NBM—7012939) The DOE Energy Conservation Program: Program summary.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Jul 1987. 23p. NTIS, PC A02; 3; GPO Dep. Order Number DE87012939/JAW.

The activities performed by the program are those that contribute to satisfying a national need. Initiatives are taken only after such needs have been identified and assessed by representative members of the entire community. In general the projects that emerge successfully from this process and are pursued by the program are those that, because of high risk, will not be undertaken by the private sector acting alone. However, the success of the program relies on the active participation and contribution of the private sector - industry, universities, and other research institutions - complemented by the significant resources available within our national laboratories.

1023 **(EUR—10600-EN) Electronic heating control system: Final report.** Fonzi, F.; de Santis, P. (Italenergie S.p.A., Sulmona (Italy)). 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900079/JAW.

The research studies the possible energy savings using devices which, at different levels of complexity, execute the control and maintain the heating system in condition of maximum efficiency. Furthermore, the devices allow a rational use of heating system, having thermal energy generation only when there is a real request. The aim of the research is to develop electronic control devices which help to reduce energy waste in heating systems by controlling electronically the combustion and the heating system (burner, thermoregulation, integrated management of several type of heating generators).

1024 **(FRNC-R—139) 1984 report on the status scientific and technical knowledge in energy conservation and raw material areas. Research programs and innovation of the French Agency for Energy Conservation (AFME).** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 46p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750280/JAW.

In this article, the 1984 report on the different actions of the French Agency for energy conservation is presented. The various components and partnerships involved with AFME are analyzed together with the strategical trends of the research and development in the energy and raw materials conservation areas. The economic investments for the various research areas (energy conservation, renewable energy sources, coal, high efficiency electricity) are presented and the principal projects for innovation are discussed: substitution fuels for vehicles, domestic energy conservation technics, photovoltaic conversion, wood, new materials.

1025 **(OME—870130/2) Energy security for Canada. Improving energy efficiency.** (Ontario Ministry of Energy, Toronto (Canada)). Jan 1987. 17p. (MICROLOG—87-04047). Ontario Ministry of Energy, 56 Wellesley St. W., 12th Floor, Toronto, Ontario, Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

This paper deals with Canada's approach to securing the future through the efficient use of energy. It examines how energy is used to meet needs and proposes a framework for ensuring that the economic benefits of improved efficiency are fully realized. 7 figs., 2 tabs.

3201 Buildings

REFER ALSO TO CITATION(S) 395, 564, 965, 1017, 1018, 1019, 1105, 1702

1026 **(AE/SESRD—1/165) Performance characteristics of energy-efficient residential furnaces.** (Alberta Energy and Natural Resources, Edmonton (Canada). Scientific and Engineering Services and Research Div.). [1987]. 11p. (MICROLOG—87-03219). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Since 1976, many projects have been initiated in Alberta by industry and by academic research institutions for better utilization of the province's energy resources. Funding for research and development efforts is supported in part by the Alberta/Canada Energy Resources Research Fund. Program priorities have focused on coal, energy preservation, renewable energy, as well as conventional energy resources. Six residential natural gas furnaces were tested and are compared in this publication for fuel efficiency and cost effectiveness.

1027 **(AE/SESRD—1/167) Practical methods to seal and insulate residential buildings.** (Alberta Energy and Natural Resources, Edmonton (Canada). Scientific and Engineering Services and Research Div.). [1987]. 11p. (MICROLOG—87-03363). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

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were measured incrementally after each type of leak source was sealed. Natural gas consumption was monitored for one year after the homes were sealed and compared with figures for the five-year period prior to sealing. The cost effective implications are discussed.

1028 **(AE/SESRD—1/169) Energy-conserving characteristics of common building materials and methods.** (Alberta Energy and Natural Resources, Edmonton (Canada). Scientific and Engineering Services and Research Div.). 1987. 16p. (MICROLOG—87-03790). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

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1029 **(BMFT-FB-T—86-198) Waiblingen municipal sewage plant, central heating unit based on an absorption heat pump using both, the waste heat from waste water and also the sludge gases for supplying a district heating system. Final report.** Huelsemann, R.; Ehrler, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Kraftanlagen A.G., Heidelberg (Germany, F.R.)). Dec 1986. 45p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750419/JAW.

1. Objective: Design concept, engineering, construction and commissioning as well as checking the economic efficiency of a gas-fired absorption heat pump, with waste water being used as heat source, and parallel utilization of sludge gases in order to ensure district heat supply to various consumers. 2. Working programme: Calculating different variants of several systems, including also an estimate of the input and energy requirements of the envisaged consumers. Optimization of the performance of an absorption heat pump boiler system taking also heat accumulator into consideration. Detail engineering covering the heat generation plant, district heat supply and consumer systems, and also construction, commissioning and supervision of the performance data. 3. Results: The entire plant has been in operation for three winters so far. Evidence was given that the contractual, guaranteed coefficient of performance was obtained. This clearly demonstrates that all expectations in connection with the technical design were fulfilled. The system got an award for energy saving technologies with a positive impact on the environment. With 2 refs., 2 tabs., 23 figs.

1030 **(BMFT-FB-T—86-218) Design of an information system that continuously measures energy-use of private households. Second stage. Final report.** Liepelt, K.; Wiesner, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Institut fuer Angewandte Sozialwissenschaft G.m.b.H. (INFAS), Bonn (Germany, F.R.); Technischer Ueberwachungs-Verien Rheinland e.V., Koeln (Germany, F.R.). Inst. fuer Energietechnik und Umweltschutz). Dec 1986. 46p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753261/JAW.

The information system ENERMETRIC will continuously measure and report volume and structure of energy-use in private households, and analyze these data by physical and socio-economic determinants. Information of such a broad and detailed nature does not exist, but will be needed for analysis and projection of user behavior and for the assessment and monitoring of energy saving potentials. Sensor measurements in the buildings will provide data on use of electricity, gas, oil and water, as well as temperature and humidity. These data are stored, checked and aggregated in a household-processor, then transmitted via telephone network to the central computer, analyzed and displayed in graphical form. In phase 2 of the project, the various system components were developed, installed in seven households and tested over a period of several months. On the basis of these data and experiences, sensor equipment and hardware have been modified and technical details of system prototype specified. In these laboratory tests, the system proved to be stable and fully operational, and produced accurate results. In the next phase, it will be demonstrated in a larger field test under real conditions.

1031 **(BMFT-FB-T—86-238) Heat losses through ventilation - research at the 'energy-test house' Kaiserslautern-Moelschbach. Final report.** Hoffmann, W.; Dostert, K.; Heinrich, H.; Vogel, S. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bauen und Forschen Partner, Kaiserslautern (Germany, F.R.)). Dec 1986. 112p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750420/JAW.

The measurements and experiences took place in the 'energy-test-house I' of the University of Kaiserslautern. The heat losses by ventilation were determined by finding out the heating-up and cooling-down characteristics using a new developed 'room'-thermometer. These results were verified in a test room, measured and mathematically described. In order to determine the frequency and duration of opening of windows, a new electronic device, decentrally employable was designed and tested. By fitting out windows with automatic closing devices, the duration of ventilation procedures was reduced and defined. Thereby by heat-losses, due to ventilation, were reduced. To change inhabitants behaviour by feedback, an IC-controlled consumption detector was mounted, indicating instantaneous and integral consumption of electrical energy of the installed heat pump. On the subject of heat losses due to ventilation, an investigation of literature was carried through. With 160 refs., 4 tabs., 35 figs.

1032 **(DOE/CE/63473—T1) WSOS Community Action Commission, Inc.: Final report.** (WSOS Community Action Commission, Inc., Fremont, OH (USA). Dept. of Housing and Energy Development). 29 Sep 1987. Contract FG01-86CE63473. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88000353/JAW.

WSOS is a Community Action Agency headquartered in Fremont, Ohio, that provides a number of services to low/moderate income individuals and their families in the Ohio counties of Sandusky, Wood, Ottowa, and Seneca. Formed in 1966, it currently employs over 150 persons, with an overall budget of over $13,000,000. Since 1980, WSOS has had a housing component that specializes in rehabilitating low/moderate income housing, as well as weatherizing low income residences. The staff of WSOS perform the assessment, cost estimations and actual work on these jobs. There has been a tendency, over the past few years for the need to fill in time for the weatherization/renovation crews.

1033 **(DOE/CE/63497—T1) New energy venture: Final report.** (East Central Arkansas Economic Opportunity Corp., Forrest City (USA)). [1987]. Contract FG01-86CE63497. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000183/JAW.

Three nonprofit WAP subgrantees in Arkansas that currently manufacture storm windows, thermal doors and thermal windows on a limited basis for sale to the public and for use in the weatherization programs intend to form NEW ENERGY VENTURES (NEV) a for-profit entity that will market their products and products from other manufacturers that complement these WAP subgrantee produced products. Participating in the venture are East Central Arkansas Economic Opportunity Corp., Forrest City, AR; Universal Housing Development Corp., Dardanelle, AR; and Southwest Arkansas Development Council, Inc., Texarkana, AR. Because of the location of the agencies throughout Arkansas, the products could reasonably be sold to individuals and businesses in the proximate areas of the neighboring states without remarkably increasing the cost of doing business. This assumption, however, will be tested during the business planning period.

1034 **(EPRI-EM—5392) Residential load control and metering equipment: Costs and capabilities: Final report.** Stickels, T.D.; Markel, L.C. (Electrotek Concepts, Inc., Mountain View, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 75p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920044/JAW.

This report summarizes the current costs and capabilities of commercially available equipment for residential load control and metering. Three categories of equipment are covered: communications systems, customer-side load control devices, and load monitoring and solid state metering equipment. The text of the report provides summary descriptions of the technologies available - their capabilities, characteristics, advantages and disadvantages. A series of tables presents budgetary cost estimates, number of systems installed, and design characteristics for the equipment offered by selected vendors. A list of vendors and contact points (names, addresses, telephone numbers) is provided. Communications systems covered in this report are radio, power line carrier, ripple, wave form modification, telephone, satellite, cable TV and hybrid systems. Customer-side devices include relays and actuators, time clocks, programmable thermostats, duty cycle limiters, smart thermostats, and demand controllers. Load monitoring and metering equipment includes kWh and kW meters, time of use meters, automatic/remote reading systems, multi-register meters, and load profile recorders.

1035 **(ERATL—87/19/XAB) Temperature rise of cables passing through short lengths of thermal insulation.** Coates, M. (ERA Technology Ltd., Leatherhead (UK)). Jun 1985. 29p. (ERA—85-0111). NTIS PC$48.00.

The work done to verify a method for calculating the temperature rise of a cable or group of cables passing through a short length of thermal insulation is described. The test arrangement is presented, together with a theoretical model and discussion of results. The results of this work show, for example, that the temperature of a 3-core 10-sq mm armored cable passing through as little as 150 mm of vermiculite insulation may be as high as 88 C when carrying its rated current, based on an ambient temperature of 30 C and a maximum temperature of 70 C.

1036 **(LBL—20364) Ventilation strategies for different climates.** Feustel, H.E.; Modera, M.P.; Rosenfeld, A.H. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 29p. (CONF-8605301—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014677/JAW.

From ASHRAE conference; Atlanta, GA, USA (1 May 1986).

Until recently, residential ventilation in the United States has been provided by infiltration. In this report we compare natural ventilation (ventilation by infiltration) with several mechanical ventilation strategies and examine the overall energy consumption associated with these strategies in different climatic regions in the US. The strategies examined are: natural ventilation, balanced ventilation with an air-to-air heat exchanger, exhaust ventilation without heat recovery, and exhaust ventilation with heat recovery via a heat pump. Two strategies for utilizing the heat pump output for domestic hot water are examined. One heat pump strategy employs exhaust fan reversal to provide space cooling whenever possible during the summer months. A modified TRNSYS residential load model incorporating the LBL infiltration model, an algorithm to calculate effective ventilation, and a modified TRNSYS domestic hot water model are used to simulate the energy consumption associated with each strategy. The domestic hot water model is used to determine the useful heat supplied by an exhaust ventilation heat pump as a function of daily hot water demand. The simulations indicate that the choice of ventilation strategy can have a significant impact on energy consumption. They show that total end-use energy consumption can be reduced as much by mechanical ventilation as by superinsulation of a house. The comparisons also show that for the same effective ventilation rate, houses with mechanical ventilation systems (especially those with exhaust fans) have been indoor air quality than those that rely on natural ventilation. 19 refs.

1037 **(LBL—21217) A comparison of weather normalization techniques for commercial building energy use.** Eto, J.H. (Lawrence Berkeley Lab., CA (USA)). Dec 1985. Contract AC03-76SF00098. 19p. (CONF-851202—16). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014813/JAW.

From DOE-ORNL-ASHRAE-BTECC conference on thermal performance of the exterior envelopes of buildings-III; Clearwater Beach, FL, USA (2 Dec 1985).

Compilations of measured energy savings have shown that engineering calculations do not always correlate well with actual performance. One important difference between engineering calculations and real world performance is the effect of weather. Energy service companies, whose profits are a function of energy savings, and building energy researchers have developed weather-normalization formulas or techniques. True tests to determine the adequacy of these methods, however, require careful control of other determinants of building energy use. This paper describes results obtained by using a building energy simulation tool to evaluate some of these methods for commercial buildings. Degree-day-based normalization techniques designed to account for the effects of weather on commercial building energy use are identified. The normalization techniques are compared using the results of DOE-2 simulations for two office building prototypes using many years of actual weather data for a single location. We conclude that, for the prototypes and location examined, the techniques performed reasonably well, and the sophisticated techniques did not perform noticeably better than the simpler ones.

1038 **(LBL—21577) Effects of low-emissivity glazings on energy use patterns in nonresidential daylighted buildings.** Sweitzer, G.; Arasteh, D.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). Dec 1986. Contract AC03-76SF00098. 16p. (CONF-870101—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000620/JAW.

From American Society of Heating, Refrigerating, and Air-Conditioning Engineers meeting; New York, NY, USA (18 Jan 1987).

Fenestration is the most significant envelope design determinant of energy use in nonresidential buildings. This paper presents our assessment of energy use effects of low-emissivity (low-E) versus conventional glazings for a range of window-to-wall ratios in a daylighted office building, in representative hot and cold climates. Low-E glazings transmit "cooler" daylight than their conventional counterparts because, for a given visible transmittance, they reflect a much larger fraction of incident solar infrared radiation. We thus use the ratio of visible transmittance to shading coefficient, which we define as K/sub e/, to compare the effect of representative glazing characteristics on component and total-building energy use, peak electrical demand, and required cooling equipment sizes. It is concluded that insulated glazings with low-E coatings can provide lighting and cooling energy savings in both hot and cold climates. The most dramatic lighting, cooling, and total electricity energy savings are achieved for increases of K/sub e/ within the range of 0.5 to 1.0; higher K/sub e/s provide diminishing savings. The increased R-value of low-E insulated glass units provides significant benefits in cold climates and is not a liability in hot climates. Low-E glazings also help increase the mean radiant temperature of interior environments in winter and reduce it in summer, and provide greater architectural design freedom without adverse energy consequences. Further, the higher first costs of these glazings may be more than offset by savings from smaller cooling equipment, energy and peak-demand cost savings, long-term financial gains from better rentals, and increased productivity due to improved occupant comfort.

1039 **(NP—7770276) Assessment of climates and flow rates behind curtain walls.** (Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.)). 1986. 48p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87770276/JAW.

The report abstracted deals with the development of measuring methods for the measurement of the climates of ventilated curtain walls and tries to assess the methods' applicability to overground buildings. Analyses essentially involve the measurement of temperatures, relative atmospheric humidity and flow rates all of

which are known to have a considerable effect on the corrosion of walls and fasteners. The results are evaluated in view of influences from without. Access is given to both the measuring set-up and the mechanical set-up, the test methods, data acquisition and sensors (thermometers, anemometers, hygrometers and others). The conclusion is dedicated to measuring results obtained with different atmospheric conditions and implications as to the practical use of methods and results in the design and construction of curtain walls.

1040 **(NP—7770278) Small indoor swimming pool at Schwalmtal. Measuring results of energy conservation analyses. Final report.** Biasin, K.; Leisen, K. (Forschungsstelle fuer Energiewirtschaft, Muenchen (Germany, F.R.)). Apr 1986. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87770278/JAW.

Measurements taken in the Schwalmtal small-scale indoor swimming pool between 1983 and 1985 proved to show that the end-use energy consumption of indoor swimming pools can be reduced to 40% of that of a comparable modern but conventional swimming pool by installing systems which are utilizing the waste heat and by installing solar absorbers. The energetic design is based on the notion that while most of the heat demand is primarily covered by heat recovery systems the remaining heat demand is covered by a solar absorber system. The paper describes the energy systems concerned and discusses the experiences gained in their operation and measuring results. The last chapter is dedicated to the planning and evaluation of the waste heat and ambient heat systems.

1041 **(NP—7770279) Small indoor swimming pool at Schwalmtal. Space HVAC systems. 3. Interim report.** Leisen, K.; Weber, T. (Forschungsstelle fuer Energiewirtschaft, Muenchen (Germany, F.R.)). Dec 1985. 99p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87770279/JAW.

A space HVAC system equipped with recuperative plate heat exchangers and heat pumps serves to dehumidify, ventilate and heat the Schwalmtal small-scale indoor swimming pool. The report shows in which way and to what extent the dehumidifying and ventilating system has been contributing to energy conservation. It deals with the space HVAC system as such, data acquisition and measuring results assessing the system's operational behaviour, evaporation and dehumidification properties, the performance characteristics of the ventilation system as well as with the humidity and energy balances. The measuring results obtained lead to modifications of the ventilation system which resulted in a reduction of the operating time of an air inlet fan by 75%. The reduction accounts for an energy conservation of 190 kWh/week. Further modifications are expected to even add to the present energy conservation.

1042 **(NP—7770280) Small indoor swimming pool at Schwalmtal. A heating system equipped with heat pumps and solar absorbers. 2. Interim report.** Leisen, K. (Forschungsstelle fuer Energiewirtschaft, Muenchen (Germany, F.R.)). Dec 1984. 116p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87770280/JAW.

The energy-conserving design of the Schwalmtal small-scale indoor swimming pool consists in a improved thermal insulation, the installation of systems recovering heat from the waste heat of the pool, showers, hall and shower rooms as well as in the installation of a heat pump heating system equipped with solar absorbers. The 2nd interim report discusses the test results of the heat pump/absorber heating system. It deals with the water heating system and points out experiences gained in its operation and energy balances. Moreover, the report refers to the components consuming the heat, the heat pump as well as to the absorbers consisting of absorber blocks and the energy roof. Measurements and tests over a period of two years lead to modifications of the energy design which are expected to be adding to the present energy conservation.

1043 **(NP—7770281) Small indoor swimming pool at Schwalmtal. Heat recovery from shower water, heat recovery from basin drain water. 1. Interim report.** Leisen, K. (Forschungsstelle fuer Energiewirtschaft, Muenchen (Germany, F.R.)). Apr 1984. 126p. (In German). NTIS (US Sales Only), PC A07. Order Number DE87770281/JAW.

This publication describes experience gathered in heat recovery from shower water and drain water from the basin of the small-scale swimming pool at Schwalmtal on the lower Rhine. The pool was first put into operation in 1982. The target set was to reduce the requirement of heating energy to some 35% of what is normally needed for such a pool. However, heat recovery by corresponding devices from shower water fell considerably short of expectations. The causes are mentioned, making reference to the evaluation of measuring data. For higher efficiency of heat recovery from shower water, the study suggests and realizes improvements. Also described are the concept and economic efficiency of devices for recovering heat from the basin water. Trends indicate that heat recovery plants are efficient economically if there is a large throughput of basin water and the plant attains long run times.

1044 **(OME—87) Energy-service contracts. Some thoughts.** (Ontario Ministry of Energy, Toronto (Canada)). 1987. 6p. (MICROLOG—87-03466). Ontario Ministry of Energy, Municipal and Commercial Programs, 56 Wellesley St., West, Toronto, Ontario, Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

In any one contract, energy-service companies may combine any or all of a variety of services related to energy-conservation management -- from financing and engineering to the purchase, installation and maintenance of equipment -- into a single package. This is done for a piece of the energy savings realized for the client. Several matters should be considered such as evaluating energy-service proposals to negotiating the contract and resolving contract disputes. The experiences of three municipalities and one business are discussed.

1045 **(OME—87) Lighting. Reducing costs and energy use.** (Ontario Ministry of Energy, Toronto (Canada)). 1987. 6p. (MICROLOG—87-03464). Ontario Ministry of Energy, Municipal and Commercial Programs, 56 Wellesley St., West, Toronto, Ontario, Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

Because lighting can be responsible for 20 to 40 percent of the energy bill, it offers considerable potential for savings. In recent years, improved lighting standards or guidelines have been developed which allow both the designers and the users of the system to choose the proper level of lighting for any specific commercial or industrial application. An inspection often reveals that less illumination would be adequate. Coupled with these new standards has been the improvement of the various types of lamps and light fixtures, resulting in better efficiency. This report cites five projects with data for the project cost, estimated annual savings and payback period. A method for calculating savings with examples is explained. 1 fig., 2 tabs.

1046 **(OME—87) Airing out the sick-building syndrome.** (Ontario Ministry of Energy, Toronto (Canada)). 1987. 6p. (MICROLOG—87-03467). Ontario Ministry of Energy, Municipal and Commercial Programs, 56 Wellesley St., West, Toronto, Ontario, Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

Symptoms of the Sick-Building Syndrome, as cited by the World Health Organization, include eye, nose and throat irritation, mental fatigue and headache, unspecific hypersensitivity reactions, nausea and respiratory diseases. To conserve energy in the early 1970's, many building owners found ways to minimize the infiltration or uncontrolled leakage of outside air into buildings. At the same time the regulated flow of fresh air or ventilation was reduced resulting in a 'tight' building that can contribute to the buildup of contaminants and bacteria. Regular inspection of air-handling units (heating, ventilation, air-conditioning) should include visual observation and microbial sampling. Proper system design and regular maintenance can control micro-organism invasion. Careful selection of building materials and cleaning products will also reduce air pollutants.

1047 **(OME—87) Control systems for managing energy consumption.** (Ontario Ministry of Energy, Toronto (Canada)). 1987. 6p. (MICROLOG—87-03468). Ontario Ministry of Energy, Municipal and Commercial Programs, 56 Wellesley St., West, Toronto, Ontario, Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

Many buildings are completely controlled by sophisticated systems that greatly reduce the possibility of human error. They can be designed to perform a wide range of functions including the control of heating and cooling systems, lights, and fire and safety systems. Electrical-demand, peak-load control devices are designed to monitor the total electrical demand of the building continuously. A predetermined peak value and order of priority are entered in the control. If the building load approaches the value, the control will begin to drop off certain electrical loads. Once the total load has dropped below the peak value, the control will allow the turned off equipment to be switched on again. Four energy projects involving control systems are described with financial data available for project cost, estimated annual savings and payback time. 8 figs.

1048 **(OME—87) Combustion. Fuel and system efficiencies.** (Ontario Ministry of Energy, Toronto (Canada)). 1987. 6p. (MICROLOG—87-03469). Ontario Ministry of Energy, Municipal and Commercial Programs, 56 Wellesley St., West, Toronto, Ontario, Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

The decision of which fuel is best for a specific application and whether to replace or upgrade an existing system depends upon such factors as fuel cost and age, size, and efficiency of the present heating system. The amount of heat released when complete combustion occurs is a constant amount per unit of fuel and can be calculated from the quantity of fuel burned. Heating values for electricity and commonly used fuels are included. Thermal efficiency describes the steady-state efficiency of a system, steady state being the situation when the boiler or furnace has been operating at a fixed firing rate continuously for long enough that all components are at a constant temperature. Steady-state efficiency can be measured with a flue-gas analysis kit and can be improved by adjusting the air/fuel ratio of the burner, increasing fan speed and replacing dirty air filters. Three energy projects are described and financial data given for cost of project, annual savings and payback time. 2 figs., 2 tabs.

1049 **(OME—87) Heritage buildings and energy conservation.** (Ontario Ministry of Energy, Toronto (Canada)). 1987. 6p. (MICROLOG—87-03465). Ontario Ministry of Energy, Municipal and Commercial Programs, 56 Wellesley St., West, Toronto, Ontario, Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ontario, Canada K1A 0G1; $10 CAN.

Since 1974, when the Ontario Heritage Act was passed, more than 2,000 residential, religious, commercial, municipal and other buildings have been officially recognized for their historic or architectural value. Effective energy conservation measures can be applied to older buildings as long as the approach is repair rather than replace wherever possible. Four cases are described in detail regarding the implementation of an energy conservation program for heritage buildings in Ontario.

1050 **(ORNL/Sub—84-21006/1) Structural thermal break systems for buildings: Feasibility study: Final report.** Larson, S.C.; Van Geem, M.G. (Construction Technology Labs., Skokie, IL (USA); Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84CE21006;AC05-84OR21400. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001508/JAW.

This report presents results from the first phase of a program to investigate lightweight concrete systems for potential use as structural thermal breaks in buildings. The primary objective of the project is to develop a portland cement concrete with sufficient thermal resistance and strength properties to serve as an effective structural thermal break in building envelopes. Desirable properties of the proposed concrete are a density of less than 50 pcf (800 kg/m^3), a compressive strength of 1000 to 1500 psi (6.9 to 10.3 MPa), and a thermal conductivity of less than 1.5 Btu . in./h . ft^2 . °F (0.22 W/m . K). The first phase of work, presented in this report, is a feasibility study to identify uses for the lightweight portland cement concrete. The report is subdivided into three sections. Section 1 presents suggested assemblies where lightweight concrete can be used in place of steel, other metal, or normal weight concrete to prevent thermal bridges or thermal bypasses. Potential uses for the proposed lightweight concrete include exterior walls, interior walls, columns, chimneys, foundations, and floor slabs. Thermal conductivity of the proposed lightweight concrete is approximately 1/10th that of normal weight concrete and 1/100th that of steel.

1051 **(ORNL/TM—10264/V3) Occupant evaluation of commercial office lighting: Volume 3, Data archive and database management system.** Gillette, G.; Brown, M. (ed.). (American Inst. of Architects Foundation, Washington, DC; Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001525/JAW.

This report documents a database of measured lighting environmental data. The database contains four different types of data on more than 1000 occupied work stations: (1) subjective data on attitudes and ratings of selected lighting and other characteristics, (2) photometric and other direct environmental data, including illuminances, luminances, and contrast conditions, (3) indirect environmental measures obtained from the architectural drawings and the work station photographs, and (4) descriptive characteristics of the occupants. The work stations were sampled from thirteen office buildings located in various cities in the United States. In the database, each record contains data on a single work station with its individual fields comprising characteristics of that work station and its occupant. The relational database runs on an IBM or IBM compatible personal computer using commercially available software. As a supplement to the database, an independent ASCII-8 bit data file is available.

1052 **(PB—87-210381/XAB) Field and laboratory evaluation of a wood-stove dilution-sampling system. June 1986-June 1987.** Merrill, R.G.; Harris, D.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jul 1987. 18p. (EPA—600/D-87/216). NTIS, PC A02/MF A01.

This paper discusses field and laboratory evaluation of a wood-stove dilution sampling system. Two sampling methods were developed and used by EPA to test emissions from wood stoves: both remove flue gas directly from the appliance chimney. The two methods were developed to meet two goals of EPA-sponsored research and development: (1) the wood stove dilution-sampling system (WSDSS) addresses the need to simulate or model the atmosphere/stack interface and to provide emissions samples as they are distributed between vapor-phase and particle-bound material; and (2) the modified method 5 (MM5) system addresses the need to perform direct-source sampling without dilution or condensation. Comparison of the WSDSS and MM5 sampling systems in laboratory tests is presented.

1053 **(PB—87-229530/XAB) HVAC seasonal performance program. Volume 1. Program description. Topical report.** Chiu, A.; Delima, H. (Applied Management Sciences, Inc., Silver Spring, MD (USA)). 19 Oct 1984. 99p. NTIS, PC A05/MF A01.

See also Volume 2, PB—87-230017.

The HVAC Seasonal Performance Program, developed to simulate the performance of different space heating and cooling equipment operating in residences or small commerical buildings, is executed from the Apple LISA microcomputer and is written in PASCAL. The equipment modeled include electric and gas-fired heat pumps and air conditioners, gas furnace, and electric add-on or hybrid heat pumps (single-speed, multispeed, and variable-speed or modulating systems). The program enables a comparative evaluation of the technical and economic performance of space-conditioning technologies. Volume I of the report contains the program description and development, code listing, and equipment submodels.

Volume II is a user's manual discussing the input parameters and program outputs.

1054 **(PB—87-230017/XAB) HVAC seasonal performance program. Volume 2. User's manual. Topical report.** Chiu, A.; Delima, H. (Applied Management Sciences, Inc., Silver Spring, MD (USA)). 19 Oct 1984. 74p. NTIS, PC A04/MF A01.

See also Volume 1, PB—87-229530.

The HVAC Seasonal Performance Program, developed to simulate the performance of different space heating and cooling equipment operating in residences or small commercial buildings, is executed from the Apple LISA microcomputer and is written in PASCAL. The equipment modeled include electric and gas-fired heat pumps and air conditioners, gas furnace, and electric add-on or hybrid heat pumps (single-speed, multispeed, and variable-speed or modulating systems). The program enables a comparative evaluation of the technical and economic performance of space conditioning technologies. Volume I of the report contains the program description and development, code listing, and equipment submodels. Volume II is a user's manual discussing the input parameters and program outputs.

1055 **(PB—87-230025/XAB) End-Use-Technology Data-Base-Management System (ENUTEC). Volume 2. Description of data and identification of sources. Report for January 1984-February 1985.** Kadalur, D.; Harris, L.R. (Applied Management Sciences, Inc., Silver Spring, MD (USA)). Feb 1985. 31p. NTIS, PC A03/MF A01.

The End-Use-Technology Data-Base-Management System (ENUTEC) is a comprehensive computerized data-base-management system that allows the user to conduct a comparative analyses of the performance of HVAC equipment. It operates on the principles of the Relational Data Base Model. The data base includes economic, technical, and market parameters and two analytical model subsystems: The HVAC Seasonal Performance Program which simulates the performance of different HVAC systems, and the Parametric Allowable Installed Cost Program which computes allowable cost and performance of research technologies. The data base includes housing data for various dwelling types with different thermal characteristics and also documents and stores energy rates and bin weather data for the 18 GRI regional representative cities. Market data may be retrieved by states, GRI regions, and GRI representative cities.

1056 **(PNL—5854-Vol.2) Development of whole-building energy design targets for commercial buildings: Phase 1, Planning: Volume 2, Technical report.** Crawley, D.B.; Briggs, R.S.; Jones, J.W.; Seaton, W.W.; Kaufman, J.E.; Deringer, J.J.; Kennett, E.W. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88000830/JAW.

This is the second volume of the Phase 1 report and discusses the 10 tasks performed in Phase 1. The objective of this research is to develop a methodology for setting energy design targets to provide voluntary guidelines for the buildings industry. The whole-building energy targets project is being conducted at the Pacific Northwest Laboratory (PNL) for the US Department of Energy (DOE) to encourage the construction of energy-efficient buildings by informing designers and owners about cost-effective goals for energy use in new commercial buildings. The outcome of this research will be a flexible methodology for setting such targets. The tasks are listed and discussed in this report as follows: Task 1 - Develop Detailed Project Goals and Objectives; Task 2 - Establish Buildings-Industry Liaison; Task 3 - Develop Approaches to the Energy Targets Model, Building Operations, and Climate; Task 4 - Develop an Approach for Treating Economic Considerations; Task 5 - Develop an Approach for Treating Energy Sources; Task 6 - Collect Energy-Use Data; Task 7 - Survey Energy Expert Opinion; Task 8 - Evaluation Procedure Specification and Integration; Task 9 - Phase 1 Report Development; and Task 10 - Phase 1 Review Planning.

1057 **(PNL-SA—14695) Graphical analysis and data presentation techniques applied to hourly building energy consumption end-use data.** Stoops, J.L.; Gilbride, P.D. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 18p. (CONF-870811—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000075/JAW.

From Energy conservation program evaluation: practical methods and useful results; Chicago, IL, USA (19 Aug 1987).

The analysis of hourly building energy consumption data collected at a detailed end-use or building equipment level is complicated by the resulting large data sets with several distinct dimensions of variability and interdependence. Understanding the driving factors of building energy consumption revealed by the data requires the development of innovative techniques of data presentation. This paper summarizes some results of analysis efforts utilizing Pacific Northwest Laboratory field collected commercial building end-use energy consumption data.

1058 **(PNL-SA—15081) Marketing environment for conservation in the northwest: Phase 2, 1985 summary of findings and implications.** Hattrup, M.P.; Ivey, D.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 22p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000561/JAW.

In July 1985, in order to analyze the marketing environment for the BPA conservation activities, PNL undertook Phase 2 of the project. The following were the three objectives of Phase 2: to track changes in consumer attitudes, interests, and opinions between 1983 and 1985; to identify more refined segments of the residential conservation market in terms of attitudes, interests, and opinions; and to test hypotheses concerning consumer conservation actions and investment behaviors. In the 1985 study, a survey of 1058 households was conducted. The survey sample was drawn from Idaho, Oregon, Washington, and Western Montana, with approximately the same number of respondents from each of the same four geographical divisions as in the 1983 sample. The analyses of the survey results are being published in a series of five reports, including the present one which is the fifth in the series.

1059 **(PTB-ATWD—28) Heat supply concept at the Physikalisch-Technische Bundesanstalt (PTB) at Braunschweig.** Helwig, N.; Scheller, W.; Halbes, W.; Haucke, G. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Allgemeine Technisch-Wissenschaftliche Dienste). Oct 1986. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753270/JAW.

Since 1973, the heating concept for the buildings of the Physikalisch-Technische Bundesanstalt (PTB) at Braunschweig has been undergoing a change. Cuts in operational cost by energy conservation are gaining weight as compared to net investment cost. At PTB, ways of how to optimize energy use and improve the efficiency of heat generation and heat transmisison are being considered. The basic aim is that of a dynamically operated heating system tuned to the immediate requirements, with minimized distribution losses. The system is to be composed of interchangeable elements and is to be as far as possible open to later variations including especially a subsequent change of energy source. All methods for heat recovery economical in the medium term are to be incorporated. As a result of this programme, the distribution network will be fully shifted to energy transmission by hot water and will be disconnected from the district heating grid by heat exchangers operated by the reverse current principle.

1060 **(UCRL—53815) Structural irregularity: A comparative analysis of the differences between dynamic analysis and the uniform building code.** Burdick, R.B. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88000014/JAW.

The purpose of this study was to examine the effect of varying mass and stiffness parameters in framed structures of uniform geometry. Although mass variations were explored, the fact that the UBC design forces are distributed independently of the struc-

tures stiffness caused the emphasis of this study to be focused on stiffness variations. This study discusses Normal Mode Analysis techniques. This chapter briefly addresses the theory used in the writing of the Dynamic Analysis Program (DAP). The code calculates story forces and shears, participation factors and base shears to be used in comparisons with UBC design forces. This report also discusses: Response Spectrum Analysis methods; discusses the Uniform Building Code; and the results from the shear distribution comparisons.

1061 **Indoor air pollution and inter-room pollutant transport due to unvented kerosene-fired space heaters.** Traynor, G.W.; Apte, M.G.; Carruthers, A.R.; Dillworth, J.F.; Grimsrud, D.T.; Thompson, W.T. (Lawrence Berkeley Lab., CA). *Environment International;* **13**: No. 2, 159-166(1987). Contract AC03-76SF00098.

Two kerosene-fired space heaters, one white-flame convective and one blue-flame radiant, were operated in the master bedroom and living room of an unoccupied house (elevation: 1800 m) under several simulated use conditions. Tests were conducted in the master bedroom with the bedroom door and bedroom window open and closed. The heaters were operated until an 8°C temperature rise was achieved in the room. Increases in bedroom concentrations of CO, CO_2, NO, NO_2, and O_2 are reported. The increases in CO_2 levels ranged from 2440 to 5440 mL/m³ (ppm) while the increases in NO_2 levels ranged from 0.12 to 0.60 mL/m³ (ppm). The NO_2 emission rate from the convective heater was reduced at the high altitude location as compared with previous emission rate measurements conducted near sea level with the same heater. In addition, inter-room pollutant transport rates are reported for bedroom tests conducted with the window closed. While inter-room pollutant transport rates were less than 10 m³ with the bedroom door closed (opening area less than 100 cm²), they ranged from 16 m³/h to 53 m³/h with the bedroom door open 2.5 cm (opening = 520 cm²), and ranged from 190 to 3400 m³/h with the door fully open (opening area = 15,000 cm²). Continuous emission rate data are reported for tests conducted with the heater in the living room.

1062 **The pattern of energy use in the UK, 1980.** Norwich, England; HMSO Books (1984). 145p. HMSO Books, Publications Div., Room 2C03 St. Crispins, Duke St., Norwich, England NR3 1PD.

This book is the second part of the Energy Efficiency Series, which is aimed at creating a wider public understanding and discussion of the efficient use of energy. It gives detailed statistics of the energy consumed by major industries, including engineering, food, drink and tobacco, chemicals and transport, as well as reporting on the domestic use of energy. This book discusses energy policy, conservation and production.

3202 Transportation

REFER ALSO TO CITATION(S) 1137, 1150, 1410, 2688

1063 **(CONF-8406364—Summs.) Research on short-distance transportation '84.** (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bundesministerium fuer Verkehr, Bonn (Germany, F.R.)). 1984. 493p. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The contributions in this book are summaries of papers from a status seminar for the research programmes 'Research and Technological Development in Urban Transport' (BMFT) and 'Research on Urban Transport' (BMV), which was held in Berlin on June 27/28, 1984, by the Federal Minister for Research and Technology (BMFT) and the Federal Minister of Transport (BMV). Separate records are available for all 40 papers.

1064 (CONF-8406364—Summs., pp 19-27) **BISON - control and information system for short-distance passenger transport. Results of phase II.** Bents. (Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The objective behind BISON is the setting up of an EDP supported operational control and information system to enable public transit companies to perform more efficiently by using all available information technologies. Starting with a function and information flow structure, worked out in Phase I of the project, and employed in various differently structured transit companies, and EDP oriented overall structure for BISON was set up in Phase II. The overall structure of BISON includes all integration units, subsystems and main functions of the complete BISON system and at the same time provides a valid foundation for the development of the individual sub-systems.

1065 (CONF-8406364—Summs., pp 28-42) **Standardized automatic passenger information system: Integration of new information media.** Neufeldt; Pasquay. (Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.; Hamburger Verkehrsverbund, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Within the scope of the project 'standardized automatic passenger information system' (STAFI), the system specification for the information of the passenger before he starts his journey is worked out. The system specification and the resulting specification constitute the concept phase of this project and build the starting point for the realisation of the system. The aim is to obtain a very large market of transport companies covering different sizes and structures. Representatives from several transport companies were involved in determining the system requirements. A general design for the standardized timetable information has been worked out. Different requirements of different transport companies are made possible by the modular structure of the design. The design of the system is also based on the results of the demonstrational operation of the automatic passenger informationssystem in Hamburg (AFI) which included the components 'automatic telephone information' and the 'automatic information machines'. In addition to this the system component 'automatic timetable information' has been developed by means of Videotex (AFI-BTX) in 1983 in Hamburg. The system is installed on an external computer and connected with the BTX-field tests Berlin and Duesseldorf of the Deutsche Bundespost (German Federal Post Office). The results will be taken into consideration when specifying the standardized timetable information.

1066 (CONF-8406364—Summs., pp 43-52) **Trial phase of the BON system.** Budig; Felz. (Hannoversche Verkehrsbetriebe A.G., UESTRA, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Within the research project 'BON' the complete system integration has been started in the middle of 1983. Because of the elaborate stage of development of the singular components, works of integration could be carried out according to plan. The operational phase of testing the system started in spring 1984. Focal points of the test program are analysis and increase of technical reliability as well as analysis of operational handling and of the benefits of the system. In this process the system is also being optimized.

1067 (CONF-8406364—Summs., pp 52-62) **Measures and technologies for decentralized acceleration of tram and bus systems.** Grund. (Krefelder Verkehrs A.G., Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The development and assessment of measures aimed at decentralized acceleration of public passenger transit must be seen against a background created by the necessity of making the tram and bus systems faster and therefore more economical and acceptable to the general public. A control model has to be set up which will generate a system comprising traffic dependent signal controls

and additional components to achieve an optimal traffic control system for both the public and private transport sectors. Aspects regarding environmental protection (exhaust emission) also be taken into consideration. A control model of this nature has already been set up at a node point in Krefeld where it is undergoing testing. All problems relevant to this control project must be dealt with the scope of an overall evaluation of the system. Of particular importance is an investigation into the multiple use of technical components (transmission from roadway to vehicle) with regard to guaranteeing transfer connections, passenger information services and command and control functions. The two currently running projects are intended to fulfil the investigatory requirements by means of traffic counting in both private transport and public transport sectors and comprehensive testing of technical transmission components taking the latest advances in microprocessing technology into account.

1068 (CONF-8406364—Summs., pp 62-68) **Testing and evaluation of a control system to ensure bus priority at traffic lights, and analysis of the applicability of the BON control system in Wuppertal.** Reichelt; Sack; Philipps. (Wuppertaler Stadtwerke A.G., Germany, F.R.; Heusch/Boesefeldt G.m.b.H., Aachen, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Bus priority at traffic lights will be tested and evaluated in Wuppertal. A decentralized control system will be realized, the control scheme is placed in the local intersection controller to modify green times (extension or reduction) to give priority to the busses approaching the intersection. Bus detection and date transmission take place with a transmitter/receiver equipment. Beacons located in the approaches will be installed to detect the bus. The IBIS-equipment in the bus defines the exact point of transmitting a radio signal to the intersection controller. Before-/after studies are planned to evaluate the efficiency of the measures. It is also proposed to evaluate the transferability of the bus priority system. An important part of the project will be to analyze the stepwise implementation of the computerized operating control system BON for transport companies.

1069 (CONF-8406364—Summs., pp 74-89) **'H-Bahn' - Dortmund demonstration project, status report.** Schlotmann; Heinke. (H-Bahn-Gesellschaft Dortmund m.b.H., Germany, F.R.; Siemens A.G., Erlangen, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

On March 8, 1983, the H-Bahn-Gesellschaft Dortmund mbH applied to the Technical Supervisory Authorities at the District President's Office, Duesseldorf, for operating approval. A series of preconditions had to be fulfilled for approval to the granted. Experts' reports had to be presented covering the special features of the automatic operation system. Various experts and the chief operator undertook acceptance tests for all system components under various operating conditions. A high degree of system reliability was confirmed following several weeks of operation without passengers. The operating company had to prepare work schedules and instructions for personnel, for training purposes and for the rescue service. After the comprehensive documentation had been checked, operating permission was granted to the Dortmund H-Bahn for the first automatic rapid transit system in the Federal Republic of Germany. Passenger operation started officially on May 2, 1984.

1070 (CONF-8406364—Summs., pp 89-102) **'H-Bahn' - Dortmund demonstration project. Special-purpose vehicle for guideway maintenance, vehicle recovery and passenger rescuing.** Mueller; Giesen. (Siemens A.G., Erlangen, Germany, F.R.; DUEWAG A.G., Duesseldorf, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

All components of the H-Bahn suspended cabin system must be regularly maintained (servicing, inspections, repairs) to ensure safe and uninterrupted operation. This paper deals with the work on the guideway, for which purpose a special vehicle was developed as a mobile aid. The vehicle is also required for vehicle recovery and for rescuing passengers. Using an autonomous drive system, the special vehicle must be able to perform inspection journeys, recover disabled vehicles' and rescue passengers. The vehicles mechanical part and electrical equipment are described. The special vehicle has already proved itself in operation.

1071 (CONF-8406364—Summs., pp 103-115) **'H-Bahn' - Dortmund demonstration system. Automatic vehicle protection system.** Rosenkranz. (Siemens A.G., Braunschweig, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The automatic vehicle protection system of the H-Bahn at the Universtiy of Dortmund is responsible for fail-safe operating of the automatic vehicles. Its functions are protection of vehicle operation and protection of passengers boarding and leaving the vehicles. These functions are managed decentrally by two fail-safe operating controllers. Besides the well-known relay-techniques of railway-fail-safe systems, electronics are applied which are based on safe operating URTL-microcontrollers. These are controlled by software stored in EPROMs. A connection link using glass-fibres serves for safe data-exchange between the two fail-safe operating controllers. The experts' favourable reports on 'train protection and safety during passenger processing' were completed in March 84; thus, transportation of passengers could start in April 84.

1072 (CONF-8406364—Summs., pp 115-125) **'M-Bahn' project. Berlin demonstration system: Projecting, design, construction.** Rosskopf; Fuhrmann; Schulz. (Berliner Verkehrsbetriebe, BVG, Germany, F.R.; Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.; Magnet-Bahn G.m.b.H., Starnberg, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

During the second half of 1983 the guideway of the project's first 600 m stage has been designed and constructed on an elevated former Berlin metro-line between the stations Gleisdreieck and Potsdamerplatz. All construction work including that for the station area, maintenance hall, and power-substation was finished at the end of March, 1984, and a maintenance Diesel-car came into operation. Until this time the complete electrical power equipment and the electronic control device has been specified, ordered and manufactured. These parts have been installed and electrically connected by April, 1984. The assembly ran first at the end of May by use of a test-carriage. At the end of June the first M-Bahn-vehicle came to Berlin. The public procedure for approval of the project's second stage began in the middle of 1983 by selecting the right of way through a suitable area. Then the formal application was submitted followed by planning of the stations and electrical designing of the facility. The necessary public licence is prepared in cooperation with the competent authorities.

1073 (CONF-8406364—Summs., pp 125-133) **'M-Bahn' project: Propulsion control unit. Operational requirements.** Hoffmann. (Magnet-Bahn G.m.b.H., Starnberg, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

For the magnetically levitated transit system called 'M-Bahn' a propulsion control unit had to be developed and tested. Based on the special requirements of the Travelling Field Guideway Propulsion System (synchronous longstator linear motor) the control units had to be able to operate several train units and take into account the compatibility with the structure of an automated train control/operations control system functioning according to the operational requirements. The boundary conditions are described as well as the technical solution which has been realized and tested.

1074 (CONF-8406364—Summs., pp 133-140) **Automatic train control and safety system for the Berlin 'M-Bahn' project: Status report.** Bachmann. (AEG-Telefunken Anlagentechnik, Berlin, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

For the first stage of the Berlin project all components of the automatic train control and safety system have been realized and tested in hardware and software. For the stepwise integration of the components developed a relatively complex test- and simulation equipment had to be built. These works enabled us to present all the functions by process-simulation in May 1984. This is an important precondition allowing to begin shortly with the trial operation of one vehicle on the 600 m long track. For the second stage which is being built under severe pressure of time automatic train control functions have been further developed since October 1983 within a detailed schedule drawn up to prove the safety of the technology applied.

1075 (CONF-8406364—Summs., pp 142-158) **Status report on research and development in urban transportation in the USA.** Benjamin. (Urban Mass Transportation Administration, Washington, DC, USA). 1984. NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The Urban Mass Transportation Technical Assistance Program is a wide-ranging support program, the emphasis of which has changed from the funding of new technological systems to working to improve existing systems. The program's budget is a minute percentage of GPN but has considerable influence on transportation. The current program emphasis is the development of sub-systems, for example, the improvement of maintenance and servicing or the development of more flexible interaction between public and private transportation systems or better information services for the travelling public. European ideas, such as pedestrian precincts and bus lanes, are similarly included.

1076 (CONF-8406364—Summs., pp 158-166) **LZB 210 CATC system in the Hamburg reference system. Status report.** Frank. (Siemens A.G., Braunschweig, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The LZB 210 CATC system is an essential part of the PUSH Hamburg Model References Installation. Its function, as safety and automation module, is the continuous monitoring of train speeds and control of vehicles. The CATC system is put into service in stages. At the lowest stage of automation, the LZB 210 carries out control operations with the retained conventional safety equipment. At the highest level, train operation is by 'moving block', i.e. operations are fully automatic, requiring no action by the driver. Following a brief outline of the LZB 210's essential components, details are given of the project's progress since May 1983. Thereby, special importance has been attached to LZB 210's maintenance and error diagnosis facility and to the carrying out of safety and function analyses. The report ends with a summary of the project's current stage.

1077 (CONF-8406364—Summs., pp 166-173) **Remote-controlled standard interface for urban railway systems. Functions and concept.** Oertel. (Stadtbahn-Gesellschaft Rhein-Ruhr, Gelsenkirchen, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

An electronic interface device specially designed for urban railway systems connects interlocking boxes with computer systems for automatic route-setting, as well as remote control and automatic train control. This device provides fail-safe features and consists of commonly available microprocessors. Attached to it is a terminal for the remote control system. It uses a high resolution colour display that bears safety responsibility and allows for unusually large track diagrams. Remote control commands are entered by directly touching the appropriate symbols on the screen.

1078 (CONF-8406364—Summs., pp 173-186) **Remote-controlled standard interface for urban railway systems. Technical implementation.** Rahn. (Standard Elektrik Lorenz A.G., Stuttgart, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

According to specifications developed by the transit authority 'Stadtbahn Rhein-Ruhr' and the first user of the system 'Essener Verkehrs-AG', SEL has developed an electronic interface device which allows a cost-optimal connection of the interlocking box to various Computer Control Systems. The interlocking box can be remotely controlled by means of a control desk and the input of the operator commands can be made at the screen directly even when they bear safety responsibility. By using 16-bit microprocessors, graphic video controllers as well as the high level programming language PASCAL, at fast image processing, a high picture resolution and easy control procedures can be achieved. First systems without safety responsibility will be implemented this year. The safety approval is scheduled for mid 1986.

1079 (CONF-8406364—Summs., pp 186-194) **SPNV 2000: Operational, traffic-related, and technical requirements on modular short-distance transportation systems.** Hartmann. (Bundesbahn-Zentralamt, Muenchen, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Today's expenditure-profit ratio in the field of short-distance passenger traffic on DB rails urgently requires an improvement of the economic situation. To achieve this, the endeavor to reduce expenditures is of prime importance. This goal is to be reached by vehicles designed in modular technique. These are vehicles constructed of individual basic elements in such a way that by combining these basic elements, an economic coverage of nearly all ranges of use is possible. In order to be able to handle the future short-distance traffic in conformity with market conditions and customer demands, it was first of all necessary to elaborate a suitable service plan in which the requirements of traffic, operation and technique had to be established and coordinated. On the basis of the resulting catalogue of requirements, the demand for research and development - particularly as regards the vehicle - was ascertained. This is to be examined in greater detail during a further stage.

1080 (CONF-8406364—Summs., pp 195-202) **'Stadtbahn 2000' - status and preliminary results.** Rothermel. (Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Improvements of future light-rail-cars in the areas of undercarriage, carbody and electric equipment are reported. The investigation of the single-axle shows further positive results. More detailed stress levels will result in weight reduction. Improvements of the electric auxiliary equipment are shown by the example of an integrated on-board control system.

1081 (CONF-8406364—Summs., pp 203-208) **Fire protection in tunnels - constructional aspects.** Haack. (Studiengesellschaft fuer Unterirdische Verkehrsanlagen e.V., STUVA, Koeln, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The conventional isolated view on vehicles, tunnels and fire fighting causes great disadvantage for an improvement of fire protection in the field of public transport railway systems especially in tunnels. To find a way out of this situation an international survey of frequencies and types of fires in tunnels was conducted and eval-

uated. The most important knowledge won is shortly described. It serves to deduce proposals concerning an improved preventive structural, operational and fire fighting protection. Corresponding indications referring to the emergency route, the reduction of structural and vehicular damage and a higher effectiveness of the fire fighting respectively are given.

1082 (CONF-8406364—Summs., pp 209-215) **Fire protection in tunnels - vehicle-related aspects.** Naumann. (Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The most important objective of the project is to determine the weak points in the individual sub-systems of an underground public transport system and to derive possibilities for improving fire safety. Based on the fact that the vehicle is the point of greatest possible fire danger in tunnels, strategies are being developed for vehicle fire protection. These are based on an analysis of the various phases of a typical vehicle fire and on danger analyses carried out within the framework of the project. Several fire safety measures are reported. Mention is made of conflicts arising from differing requirement specifications in vehicle design. Fundamental improvements in fire safety as far as vehicle design is concerned have not yet been achieved. Informative data are a prerequisite to the initiation of such a development.

1083 (CONF-8406364—Summs., pp 215-232) **Buffer collision force and static test force in urban railway vehicles.** Schneider; Bugarcic. (Technische Univ. Berlin, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

At this time the stability of urban railway vehicles in longitudinal axis is tested by a static test force of F/sub WK/=800 kN for subway vehicles and F/sub WK/=200 kN for tramway vehicles. This inflexible test method makes difficult the weight reduction of rolling stock, which is necessary for saving energy. For that reason a procedure was derived, which makes it possible to calculate the level of the test force in a differentiated way. Basing on experimental and analytical investigations of several collisions of a train against a motionless and rigid obstacle the energy absorbing elements of the coupling were improved to an optimum. Moreover, two constructions were developed to implicate the coach body in the energy-absorption. It was found that a proportional force-displacement-characteristic, which includes all energy absorbing elements at one end of the vehicle, produces best results. After that a simple procedure for calculating the level of the test force was derived, which takes account of the most important parameters. This procedure bases on a collision of a train against a resting and braked train and can be used for tramways and subways in the same way. To simplify this calculating procedure a graphic method was added to the numerical one. Concluding the force-displacement-characteristic of the energy absorbing elements of the buffer stop were adapted to the characteristic of the energy absorbing elements of the vehicles.

1084 (CONF-8406364—Summs., pp 233-236) **Investigations into the shortening of the wheelbase of motor bogies for urban railway vehicles. Preliminary results.** Bugarcic; Lamprecht. (Technische Univ. Berlin, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

During the last years new small-size asynchronous motors for three-phase alternating current were developed. Using these motors the wheelbase of motor bogies for urban railway vehicles can be shortened if the safety of running and the vehicle's stability on the track is not reduced. In order to limit the necessary amount of expensive experiments analytical investigations of the running safety of motor bogies with a shortened wheelbase were carried out. Because of the positive results the project appears to be successful. At the moment existing computer-program for vehicle dynamics is further developed to deal with urban railway vehicles as well. The concluding report for the whole project should be finished by June 1985.

1085 (CONF-8406364—Summs., pp 237-249) **Concept for a future urban railway system.** Gerndt. (Rhein-Consult G.m.b.H., Duesseldorf, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Light rail transit is a modern rail-based urban and interurban mass transit system of high performance. It has to be analysed with regard to the available technical potential and the economic conditions of each application. The given definition leads on the one hand to its specific function in comparison to bus and heavy rail transit and on the other hand to a differentiation between a modern streetcar service and light rail rapid transit. The main criteria are the general function of transport, the maximum transport capacity and the average operating speed. The operational characteristics of the system are influenced by the different degrees of independence from inherent or external constraints.

1086 (CONF-8406364—Summs., pp 249-260) **Cost reduction in tunnelling for urban underground railways.** Blennemann. (Statens Provningsanstalt, Stockholm, Sweden). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Tunnelling for urban underground railways or light railways has been criticized repeatedly in recent time because of its high costs. The rise of costs over the last years has several reasons like rise of wages and construction prices, higher requirements regarding construction and equipment, large-scale design etc. Some factors influencing the tunnelling costs and the starting points for cost reduction are pointed out and discussed. The most effective possibilities of cost reduction exist in the very early stages of planning, when basic decisions are taken e.g. regarding the total network length, the gradient level, design data etc. But later stages, e.g. the period of construction, should not be neglected under aspects of cost saving. For all considerations for cost reduction the dependencies between investment costs and costs of operation should be analysed carefully.

1087 (CONF-8406364—Summs., pp 261-276) **Connection of an urban railway system to the regional Bundesbahn network, illustrated by the example of the Karlsruhe region.** Bernstein; Drechsler; Rieke; Wegener; Ludwig. (Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Strassenbau und Eisenbahnwesen; Albtal-Verkehrs-Gesellschaft m.b.H., AVG, Karlsruhe, Germany, F.R.; Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.; Brown, Boveri und Cie A.G., Mannheim, Germany, F.R.; Stadtwerke Karlsruhe, Germany, F.R. Verkehrsbetriebe). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Object of the investigation is the connection of the internal light rail network with the regional Bundesbahn network in order to create quick connections from the region into the city without the need to change. The present infrastructure should be largely utilized to keep the expenses low. The available light rail cars should get a new drive system to operate on lines with different energy supply - direct current 750 V/alternating current 15 kV/independent of the wire.

1088 (CONF-8406364—Summs., pp 278-302) **Final report on bus standardisation as a basis for serial production and report on the trial operation of the UE 80 overland bus.** Schultz. (FFG Fahrzeugwerkstaetten Falkenried G.m.b.H., Hamburg, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

This report marks the end of the 18-months test period of the OeNV-bus Ue 80 which is to provide overland transport with a bus accomodating the latest technology. The use of 19 test vehicles produced by the companies Daimler-Benz, Iveco-Magirus, Auwaerter-Neoplan and Kaessbohrer, in 13 transport companies in West Germany, was accompanied by a questionnaire action. The transport operators, with a view to economy of operation and dependability desired: Improvement in aeration, manoeuvrability, fuel consumption, maintenance, cleaning, both exterior and interior and more extensive allowances for the requisites of overland travel. The evaluation and implementation of the improvement proposals produced by the questionnaire action will ensure for the serial production that the transport operators have at their disposal a technically improved vehicle with economic advantages and of modern design.

1089 (CONF-8406364—Summs., pp 303-308) **Brake energy storage systems with integrated pressure storage units for urban transportation.** Hagin. (Maschinenfabrik Augsburg-Nuernberg, M.A.N. A.G., Muenchen, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

As known from previous reports, the tests with the Hydrobus resulted in important know how which led to the conception of Hydrobus III. This conception is based on a hydromechanical power split transmission developed by M.A.N. In the hitherto existing solutions the brake energy storage systems (accumulator and hydromachine) was always connected to the outputshaft while a primary hydromachine was mostly joined to the inputshaft of the transmission. In this new conception the inputshaft, the outputshaft and the two hydromachines each act on their own shaft of a planetary differential pertaining to the power split transmission. This offers the possibility for each given output speed to determine at random the input speed and the input torque, or the speed of one or the other hydromachine. As compared to Hydrobus II this particularly flexible mode of operation, as well as the improved layout bring advantages concerning fuel saving, simplicity, economy, increase of power, noise reduction and safety.

1090 (CONF-8406364—Summs., pp 309-319) **Brake energy recovery with pressure storage for urban vehicles - environmentally acceptable garbage trucks.** Ruehmann; Winkler; Kriedel; Paulsen. (Maschinenfabrik Augsburg-Nuernberg, M.A.N. A.G., Muenchen, Germany, F.R.; Berliner Stadtreinigungs-Betriebe, BSR, Germany, F.R.; Studiengesellschaft Nahverkehr m.b.H., SNV, Berlin, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Due to their inefficient operation garbage trucks have a relatively high fuel consumption. This is because the diesel engine designed for running the vehicle is working at a low load level when powering the secondary hydraulic engine. The fuel consumption at this level is 4 to 5 times higher than at the best-point. In this project a drive-structure is therefore to be developed to reduce the fuel consumption as well as emissions and to allow a very quiet operation of the garbage truck. To reach this aim it was necessary to receive detailed information on the energy consumption during different operational phases, such as standing, collecting, running. The investigation has shown that 54% of the operational time the vehicle collects garbage. During this time the fuel consumption is three times higher than the idle-consumption of a comparable engine. Using the data determined in the pre-examination it was possible to develop a drivestructure which is mainly based on conventional parts. First calculations have shown that it seems to be realistic to save nearly 25% of fuel by this system. Economic studies show that an extra price of nearly 7% for the vehicle could be accepted by the customer if 25% of fuel could be saved. The potential of application for garbage trucks in the F.R.G. is corresponding to nearly 10 000 registered vehicles. A statement whether the drive-system is transferable to other vehicles can be made after the system has been tested in practice.

1091 (CONF-8406364—Summs., pp 319-326) **Magnetic engine and energy storage systems for urban buses.** Heeg. (Magnet-Motor G.m.b.H., Starnberg, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Modern propulsion- and energy storage components for use in urban buses are developed by Magnet-Motor GmbH. This paper covers definition and function of the magnetodynamic energystore used as intermediate energystore as well as it reports component measurements and final results from test bench trials with magnet-motor and generator.

1092 (CONF-8406364—Summs., pp 351-362) **Essen track-guided bus system - trial operation.** Boegner, J. (Essener Verkehrs-A.G., Essen, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Buses in Essen's city area and on the main access roads suffer today, in some cases seriously, from road sharing with private transport. Existing tunnels on approximately the same routes, constructed for light rail and tram systems, already cross under the severely overburdened city centre. The question therefore suggests itself, whether the advantages of rights of way forbidden to normal traffic should not also be used for buses. Since 1979, the Essener Verkehrs-AG, sponsored by the Federal Minister for Research and Technology (BMFT), has been working on the planning research, constructive production and step by step realization of an operational demonstration with 'Dual-Mode' buses and 'track-guided' buses aimed finally at achieving a combined operation of trams and buses on the same tracks, without limiting the mobility of the bus system. After completion of a theoretical study it was clear however, that the best way of proceeding with the project was a step by step development and testing of the individual components required in the system.

1093 (CONF-8406364—Summs., pp 363-369) **Trial operation of electronic, track-guided buses in Fuerth.** Jockusch. (Stadtwerke Fuerth, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

On May 28, 1984 the 18 month demonstration operation for electronically track guided buses started in Fuerth. The work on the bus lanes along Koenigswarterstrasse and on the maintenance and storage facility necessary before starting operations will be described in greater detail. Before the start of the demonstration operation, additional work, such as the setting up of service and operational instructions for driving personnel and work aimed at clarification of insurance legislation had to be carried out. Four routes are being investigated for later reference operation. These are all located in the city centre. The reconstruction of the urban transit stops at the new bus terminal located at Bahnhofsplatz represents an additional project. The results of a benefit analysis are being prepared for the reference operation. Even though benefits can, generally speaking, not be quantified, advantages are expected both from the point of view of the user and the operator and general public. Of immediate importance is a political decision concerning changes to the Gemeindeverkehrsfinanzierungsgesetz (legislation regarding central government financing for improvements to regional traffic installations) to enable the funding of the equipment of the vehicles which accounts for the main part of the capital requirement of DM 3,365,000.

1094 (CONF-8406364—Summs., pp 374-382) **RETAX - end of the test phase and initial operation under municipal management.** Zeitvogel. (Zweckverband Grossraum Hannover, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The operational results of the computer-controlled 'Retax' bus system have shown that exclusive area operation under the present legal provisions as well as the current state of technical development is not possible at public short-distance transport system prices. It is to be assumed, however, that in the near future the preconditions in this respect will be improved decisively by the spreading of new technologies of communication, as for instance teletext (Btx). The operational conception introduced in Wunstorf is essentially founded on the idea that basic route and time buffers for the operation of the alternative stops have been pre-planned in consideration of known data derived from the amount of traffic and other sources, and on the idea that an arrangement on these preplanned routes takes place. This conception has stood the test; despite a reduction of expense of 30% the availability of the offer has not been limited, waiting periods for passengers have only inconsiderably increased. In contrast to area operation the refusals of desired routes have been reduced nearly to zero. With regard to costs, the cost level of line-haul service could be reached with this operational conception despite a service level which has considerably increased. The putting into service of this operational conception in connection with the results achieved represents an essential milestone for a permanent operation of request-bus operation in Wunstorf under municipal management.

1095 (CONF-8406364—Summs., pp 382-402) **Demand-oriented RUFBUS system: End of the test phase and start of operation.** Gerland. (Rufbus G.m.b.H. Bodenseekreis, Friedrichshafen, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The gradual implementation of the 'flexible mode of operation (BFB)' began in May 1983, operation of the final stage of BFB development started on 28th March, 1984. This brings to a close the technical development (hardware and software) of BFB and means that, for the first time, an EDP supported system is available for controlling an integrated transit service comprised of the three elements 'line haul', 'route deviation corridor' and 'demand actuation'. The backbone of the BFB service is formed by the existing rail and bus lines, which are supplemented where necessary by demand oriented RUFBUS operation in route deviation corridors and/or freely demand actuated. Deployment of school bus service and the inclusion of taxis and special services is planned. Flexible extension or reduction of the 'route deviation corridor' and 'demand actuated' services is possible to meet changing transit or political requirements. From the transit point of view, BFB currently offers passenger information service, trip disposition and transfer guarantees. Operation is supported by a control centre with a uniform data base handling route planning, scheduling, personnel planning, operational supervision and operational and transit statistics as well as operational accounting. Operational testing is to be carried out until 30th September, 1984. The main test objectives include determining and eliminating functional weaknesses in the system, stabilizing the system components, increasing reliability and capacity of the system as well as quantifying cost and profit data relative to system parameters and operational investment. Starting with the winter schedules 1984/1985, measures are planned to introduce BFB operation in the long term and put it into series production as well as deploying it in further transit areas.

1096 (CONF-8406364—Summs., pp 403-416) **Cab guidance system - requirements and status report.** Zacharias; Sparmann. (Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.; Studiengesellschaft Nahverkehr m.b.H., SNV, Berlin, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

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There have been increasing calls from taxi operators for a taxiguidance system based on single, functional modules which can be financed one at a time and thus permit a picemeal extension of their system up to the point of full automation. It is the purpose of this research project to develop such a system in response to these demands. A preliminary investigation clarified the operational and technical prerequisites. On the basis of this study, two firms began, in 1983, to develop, construct and test one aspect of such a system, i.e. the communication between client and headquarters. The results lead us to conclude that our chosen format - a close cooperation between the research consultant, the taxi operators and the firms in charge of development - has been essential for the success of that project. Under the auspices of the research grants for the umbrella project ('Development of Components'), and based on the results on such projects as BON, BFB etc., we have now begun to look into the module 'Wireless Data Transfer' and 'Vehicle Tracing'. A parallel project is investigating the module 'Central Data Processing'.

1097 (CONF-8406364—Summs., pp 416-425) **Integration of cabs and hired cars in urban transportation systems.** Bernauer. (Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.; Studiengesellschaft Nahverkehr m.b.H., SNV, Berlin, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Integrating taxis and limousine services into the public transit system has become a major goal in designing new forms of public transportation. Expanding the spectrum of possible use for these vehicles - for both scheduled and on-demand service - requires, first of all, a qualitative and quantitative analysis of the current state of affairs in this area. Administrative, organizational, technical, and legal issues as well as the respective traffic patterns had to be investigated. This investigation was to find out if, and in what ways, taxis and limousine services could actually be incorporated into the public transit system. In addition, the results were interpreted against the background of experiments and tentative models for regular, scheduled and supplementary public transit. As a result, we developed a generalized concept for integrating the two systems and proposed possible forms of service, organization, and financial calculation. Included were legal issues and comments on contractual relations between the partners.

1098 (CONF-8406364—Summs., pp 426-443) **Handicapped persons in urban transportation. TELEBUS for the handicapped in West Berlin, modular system concept for Telebus, special passenger cars for handicapped persons.** Senst; Kirscht. (Studiengesellschaft Nahverkehr m.b.H., SNV, Berlin, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The projected extension of the Telebus-services was completed by the end of 1983. Today, a total of 4900 handicapped persons, wheel-chair users for the most part, are entitled to use this service, and up to 700 requests are received every day.

1099 (CONF-8406364—Summs., pp 443-453) **Applicability of the Dutch Buurtbus system in the Federal Republic of Germany.** Proksik; Steger; Boor de. (Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The study sets out to investigate whether the Dutch Buurtbus system is suitable to help in solving the problems of rural transport services in the Federal Republic of Germany and to what extent the system characteristics can be transferred to German conditions and the points to be taken into account when setting up a German neighbourhood bus project. After an introductory summarized presentation of the Dutch Buurtbus system and the regional characteristics of both countries, the study deals with legal questions arising in connection with the introduction of this system to the Federal Republic. These mainly concern the PBefG (Passenger Transport Act) and questions of liability, tax and contract law. Reference is also made to the Dutch system in the presentation of transportational and operational aspects of neighbourhood bus system. In the section dealing with economic feasibility and financing of a neighbourhood bus system, a cost estimate for a neighbourhood bus is provided on the basis of the Dutch data. Existing possibilities for regional financing are also described. As far as the organization of a

neighbourhood bus system is concerned, questions have to be answered regarding both the design of the system and the actual realization of the project. Here the study relies on the Dutch scenario as far as possible.

1100 (CONF-8406364—Summs., pp 454-480) **Status report on the Bodenseekreis public transportation model.** Sparmann; Roennau; Neidhardt. (Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.; Studiengesellschaft Nahverkehr m.b.H., SNV, Berlin, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

Main objective the exemplary investigation of public transit in the Bodenseekreis has been the inclusion of a new vehicle monitoring system based on flexible bus operation, called BFB. First a basic concept has been developed based on fixed route and scheduled operation. Then those lines or parts of it were substituted by BFB-operation that are supposed to be in favour of a location or time dependent flexible bus operation. Thus at least the remaining fixed route lines in both concepts are identical also including the quality of service. So differences between both resulting from the different operation schemes are fully comparable.

1101 **(PB—87-213922/XAB) Energy-management guidelines for rail-transit systems. Executive summary. Final report, 9 July 1984-30 October 1986.** Uher, R.A.; Sharma, O.N. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Rail Systems Center). Sep 1986. 19p. NTIS, PC A02/MF A01.

See also PB—87-213930.

The cost of electricity is a significant portion of the operating costs of rail-transit systems. The impact of increasing energy costs is felt by those systems presently in operation and will be felt by those in the planning or construction phases. Concerned by rising energy costs, managers of several rail-transit authorities have established energy-management programs. The objectives of these programs are energy cost reduction and improved energy efficiency. Both goals enhance rail-transit productivity. As a rule, energy management can foster its largest payoff when it is initiated during the design and construction phase of a rail-transit system. The high dollar savings occur because low-energy-cost technology and operating practices can be engineered into the system at the outset. However, changes in technology and operations of present transit systems can also reduce the electric bill. Reduction of energy cost can be achieved through energy conservation, load management, and power-rate intervention. These guidelines describe the tools and methodologies for assessing energy-conservation strategies and power-rate-structure modifications.

1102 **(PB—87-213930/XAB) Energy management guidelines for rail-transit systems. Volume 1. Final report, 9 July 1984-30 October 1986.** Uher, R.A.; Sharma, O.N. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Rail Systems Center). Sep 1986. 94p. NTIS, PC A05/MF A01.

See also PB—87-213922, and PB—87-213948.

The Energy Management Guidelines Manual is organized into two separate volumes and an executive summary. Volume I is devoted to procedures. It contains four sections. Section 2.0 develops the basic of energy cost. Sections 3.0 and 4.0 are concerned with the procedures for establishing energy-management programs during rail-system design and construction and for systems presently in operation. Section 5.0 contains a glossary of terms, and Section 6.0 contains a bibliography of projects, reports, and papers on the subject.

1103 **(PB—87-213948/XAB) Energy-management guidelines for rail-transit systems. Volume 2. Final report, 9 July 1984-30 October 1986.** Uher, R.A.; Sharma, O.N. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Rail Systems Center). Sep 1986. 315p. NTIS, PC A14/MF A01.

See also PB—87-213930.

The Energy Management Guidelines Manual is organized into two separate volumes and an executive summary. Volume II contains the methodologies, analyses techniques and strategies, which can be used to achieve the goals of increased energy efficiency and lower energy cost. Examples of the application of these techniques and strategies are also included. Section 1.0 deals with energy-conservation strategies for reducing energy consumption. The role that modification of the power-rate structure plays, through rate negotiations/intervention, is discussed in Section 2.0. Section 3.0 addresses the topic of load management, which can reduce power demand, thus lowering the demand component of the electric bill. Section 4.0 presents a description of the Energy Management Model (EMM) which is a tool used to simulate traction operation and its resultant energy consumption on a rail-transit system. Section 5.0 discusses the methodologies and analytical tools necessary to conduct an energy audit on a rail transit system. The audit is an important step in identifying opportunities for energy-cost reduction.

1104 **(UCRL—95275-Rev.1) Interplanetary propulsion using inertial fusion.** Orth, C.D.; Hogan, W.J.; Hoffman, N.; Murray, K.; Klein, G.; Diaz, F.C. (Lawrence Livermore National Lab., CA (USA); Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.; Jet Propulsion Lab., Pasadena, CA (USA); National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). Jan 1987. Contract W-7405-ENG-48. 23p. (CONF-870102—29-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014342/JAW.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Inertial fusion can be used to power spacecraft within the solar system and beyond. Such spacecraft have the potential for short-duration manned-mission performance exceeding other technologies. We are conducting a study to assess the systems aspects of inertial fusion as applied to such missions, based on the conceptual engine design of Hyde (1983) we describe the required systems for an entirely new spacecraft design called VISTA that is based on the use of DT fuel. We give preliminary design details for the power conversion and power conditioning systems for manned missions to Mars of total duration of about 100 days. Specific mission performance results will be published elsewhere, after the study has been completed.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 436, 469, 471, 939, 1029, 1029, 1043, 1062, 1132, 1410, 1523

1105 **(AFME—83-1080) Feasibility study of industrial heat recovery with aquifer storage (Bouviers test facility).** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 90p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750283/JAW.

An industrial waste heat recovery system has been studied. The interseasonal heat storage is managed through the aquifers and ground waters. The system is used for space heating of the Bouviers center and its annex buildings (school, sport hall, ...) and the waste heat is produced by a gas turbine. The energy efficiency is good (46 pc for the storage, 59 pc for the global system) but, due to very scarce utilization (230 hours per year) the economical efficiency is poor. A co-utilization with other research centers in the vicinity is expected.

1106 **(CERI—8703/24) Industrial cogeneration in Canada: prospects and perspectives.** Reinsch, A.E.; Battle, E.F. (Canadian Energy Research Institute, Calgary, Alberta). Mar 1987. 59p. (MICROLOG—87-02808). Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, Alta., Canada T2L 2A6; $30.00 CAN.

Industrial cogeneration is one alternative source of electric power to meet a part the forecast load growth. Cogeneration is the simultaneous production of electric power and useful thermal energy in one technological process. An industrial cogeneration facility supplies thermal energy (steam) to the production process and electricity to meet a portion or all of a company's plant requirements and, in some cases, provide surplus electric power to the utility grid. The principle advantage of cogeneration over conventional utility electric power generation is in the efficiency of input energy use. A conventional utility power generation technology converts

some 35% of input energy to electric power. By utilizing both the thermal and electric energy process, a cogeneration facility can yield overall energy efficiency in the range of 80 to 85% of input energy. This study examines the technical, economic and financial aspects of industrial cogeneration development in Canada. The study also provides a thorough discussion of the perspectives of industry, electric utilities, and governments as to costs, benefits, and desirability of adoption of industrial cogeneration technology. 39 refs., 7 figs., 13 tabs.

1107 **(CONF-8703180—Absts.) Biological treatment of industrial waste gases. State of the art and comparison with physico-chemical processes. Abstracts.** (Deutsche Gesellschaft fuer Chemisches Apparatewesen, Chemische Technik und Biotechnologie e.V. (DECHEMA), Frankfurt am Main (Germany, F.R.); Verein Deutscher Ingenieure (VDI) - Gesellschaft Verfahrenstechnik und Chemieingenieurwesen (GVC), Duesseldorf (Germany, F.R.); Verein Deutscher Ingenieure (VDI) - Kommission Reinhaltung der Luft, Duesseldorf (Germany, F.R.)). 1987. 223p. (In German and English). NTIS (US Sales Only), PC A10/MF A01. Order Number DE87753264/JAW.

From International meeting on biological treatment of industrial waste gases; Heidelberg, F.R. Germany (24 Mar 1987).

The main issue of the meeting was the new technology of biofiltration, which is to reduce or prevent pollution from unpleasant smells. Physico-chemical and biological processes were investigated in a comparative analysis.

1108 (DOE/METC—87/6077, pp 10-18) **Advanced coal-fueled industrial cogeneration gas turbine system.** Smith, K.O.; LeCren, R.T. (Solar Turbines Inc., San Diego, CA). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23166.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

Advances in coal-fueled gas turbine technology over the past few years have served to provide new optimism that the problems demonstrated in the past can be economically resolved and that the coal-fueled gas turbine can ultimately be the preferred system in the appropriate market application sectors. Solar's technical approach is to advance a complete coal-fuel gas turbine system that incorporates near-term technology solutions to both the historically-demonstrated problem areas such as deposition, erosion and hot end corrosion, and to the emergent environmental constraints based on nitrogen oxides and sulfur oxides. Three critical technology elements are included in this approach, namely: two-stage slagging combustor; particulate rejection impact separator; and coal fuel. These technologies have already been tested. The current program builds upon this critical technology base to move towards a full engine system solution. The paper discusses the system configuration, market studies, and competitive economics of the coal-fueled cogeneration gas turbine. 3 references, 2 figures, 2 tables.

1109 **(DOE/NBM—7012450) Research and development in sensor technology: The DOE industrial energy conservation program.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Industrial Programs). Apr 1987. 23p. NTIS, PC A02; 3; GPO Dep. Order Number DE87012450/JAW.

Sensor technology is an important component of modern day process technologies. It lends itself to further research and development with the potential for increased energy efficiency and productivity. Sensors are used by industry in practically every aspect of the production process. The utilization of automatic control systems and the anticipation of increased future applications of computers in production processes have highlighted the importance of research in this area. Recognizing this need, IP has funded a series of targeted projects to develop process-specific sensors as well as sensors for generic applications. This brochure describes, in summary form, the Office of Industrial Programs' research and development (R & D) efforts in the advancement of sensor technology.

1110 **(EGG-M—18486) The development and field testing of a high temperature ceramic recuperator.** Childs, F.W.; Sohal, M.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 6p. (CONF-860607—4). NTIS, PC A02. Order Number DE87014874/JAW.

From 8. annual energy technology conference; Houston, TX, USA (17 Jun 1986).

Under cost-shared funding with the US Department of Energy and the Gas Research Institute, AiResearch Manufacturing Company, Torrance, California has developed a ceramic/metallic hybrid recuperator to operate in dirty industrial flue gases up to 2500°F. The recuperator assembly is designed to provide up to 2000°F preheated combustion air from 2500°F flue gas. The 2000°F air preheat temperature provides over 50% savings in fuel consumption compared to an unrecuperated furnace. The assembly consists of a ceramic recuperator in series with a conventional plate-fin metallic recuperator. The ceramic recuperator consists of 1.5 in. OD silicon carbide tubes with internal cruciform baffles to enhance heat transfer. A recuperator system for a 20 MM Btu/h furnace was designed, fabricated, and installed in the flue gas of a rotary forging furnace at Cameron Iron Works, Inc., Houston, Texas. The system has operated successfully for about 2500 hours in the six months starting in November 1985. A maximum air preheat temperature of about 1900°F was achieved with a flue gas temperature of about 2100°F.

1111 **(EUR—10324-EN-IT) Design, construction and testing of a hermetically sealed 100 kW organic Rankine cycle engine for medium temperature (200-400°C) heat recovery: Final report.** Angelino, G.; Gaia, M.; Macchi, E. (Turboden s.r.l., Milano (Italy)). 1985. 74p. (In English and Italian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900087/JAW.

An organic fluid engine of 100 kW(e) rating, producing power and hot water from waste heat down to about 200°C, is illustrated both in its design and fabrication aspects. Main data for the heat transfer equipment (evaporator, condenser and regenerator) and for the two stage direct-drive 3000 rpm turbine are reported. The test stand, featuring a fuel fired heat transfer oil heat source loop is illustrated. Performance tests are presented at various working fluid evaporation and condensation temperatures. An overall efficiency (electric energy to heat) in excess of 14% was obtained despite the low temperature span. A case study is carried out, mainly with respect to the economic aspects of the engine use, with reference to an actual industrial situation, where waste heat is available as a exhaust gas flow at about 200°C. Payback times in excess of 5 years are obtained if only the electric power output of the engine is considered. The use of the condenser waste heat, even for a fraction of the time, can lower the pay back time down to less than 3 years.

1112 **(EUR—10806-EN) A theoretical and experimental investigation of absorption cycle heat pumps for industrial processes.** Heppenstall, T. (International Research and Development Co. Ltd., Newcastle upon Tyne (UK)). 1986. 80p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900081/JAW.

IRD have carried out a collaborative investigation with Newcastle Polytechnic into the theoretical and experimental operation of water/aqueous Lithium Bromide absorption cycle heat pumps. The main aim of the work was to obtain data which could be used for the design of an industrial prototype. The cycle has been analyzed theoretically and performance predictions obtained for relevant operating conditions over the range of practical interest.

1113 **(PB—87-218699/XAB) Non-catalytic denitrification control system in refuse-incinerator plants.** Ase, H.; Yamagishi, M.; Yokoyama, T.; Taguchi, S. (Nippon Kokan K.K., Tokyo). 1987. 6p. NTIS, PC E04/MF A01.

Included in Nippon Kokan Technical Report Overseas, No. 49, 46-51(May 1987).

The design of an automatic controller is not easy in the non-catalytic denitrification process because of the fluctuation in the concentration of generated NOx and the denitrification characteris-

tics. Therefore the process has been performed manually. The authors analyzed the process characteristics by applying statistical methods to the estimation of the generated NOx concentration and have clarified that difficulties of controller design lie in large disturbances, large process delay and large characteristics change. They have adopted the modified Smith predictor as a suitable controller. This automatic controller was applied to an actual refuse-incinerator plant and has shown good performance with respect to reliability of clearing required NOx concentration, reduction of NH_3 consumption, and elimination of problems caused by unreacted NH_3.

1114 **(PB—87-227286/XAB) POHC (principal organic hazardous constituent) analysis methods for hazardous-waste incineration. Volume 1, Part 1. Final report, April-December 1981.** James, R.H.; Finkel, J.M.; Dillon, H.K.; Miller, H.C.; Wensky, A.K. (Southern Research Inst., Birmingham, AL (USA)). Aug 1987. 327p. (SORI-EAS—86-1105). NTIS, PC A15/MF A01.

See also Volume 1, Part 2, PB—87-227302 and PB—84-155845.

This report gives preliminary data on methodology for candidate principal organic hazardous constituents (POHCs) that represent a variety of compound types, including alcohols, esters, chlorinated aliphatics and aromatics, carboxylic acids, aliphatic and aromatic amines, nitrated aromatics, nitrosamines, hydrazines, nitriles, organosulfur compounds, and polynuclear aromatics and heterocyclics. This work (and that under Contract 68-02-3696, Task 1) involved the evaluation of generalized GC/FID, GC/MS, and HPLC/UV methods for determining approximately 170 compounds from the approximately 400 compounds in Appendix VIII, Part 261, 40 CFR. However, the survey-analysis portion of waste characterization often targets specific compounds for determination in incinerator effluent that are not amenable to previously developed methods. Therefore, current research involves the development of specific GC/FID, GC/MS, and HPLC/UV methods for the determination of several of these compounds. The EPA has proposed regulations for owners and operators of facilities that treat hazardous wastes by incineration to ensure that these incinerators will be operated in an environmentally responsble manner. The primary criterion upon which the operational specifications are based is the destruction and removal efficiency (DRE) of the incinerator (= or > 99.99%).

1115 **(PB—87-227294/XAB) POHC (principal organic hazardous constituent) analysis methods for hazardous-waste incineration. Volume 1, part 2. Final report, June 1982-June 1983.** James, R.H.; Finkel, J.M.; Miller, H.C. (Southern Research Inst., Birmingham, AL (USA)). Aug 1987. 467p. (SORI-EAS—86-1125). NTIS, PC A20/MF A01.

See also Volume 1, Part 1, PB—87-227286 and Volume 2, PB—87-227302.

This report gives preliminary data on methodology for candidate principal organic hazardous constituents (POHCs) that represent a variety of compound types, including alcohols, esters, chlorinated aliphatics and aromatics, carboxylic acids, aliphatic and aromatic amines, nitrated aromatics, nitrosamines, hydrazines, nitriles, organosulfur compounds, and polynuclear aromatics and heterocyclics. This work (and that under Contract 68-02-2685, Task 111) involved the evaluation of generalized GC/FID, GC/MS, and HPLC/UV methods for determining approximately 170 compounds from the approximately 400 compounds in Appendix VIII, Part 261, 40 CFR. However, the survey-analysis portion of waste characterization often targeets specific compounds for determnation in incinerator effluent that are not amenable to previously developed methods. Therefore, current research involves the development of specific GC/FID, GC/MS, and HPLC/UV methods for the determination of several of these compounds. The EPA has proposed regulations for owners and operators of facilities that treat hazardous wastes by incineration to ensure that these incinerators will be operated in an environmetally responsible manner. The primary criterion upon which the operational specifications are based is the destruction and removal efficiency (DRE) of the incinerator (= or >99.995).

1116 **(PB—87-227302/XAB) POHC (principal organic hazardous constituent) analysis methods for hazardous-waste incineration. Volume 2. Final report, April 1983-April 1984.** James, R.H.; Adams, R.E.; Miller, H.C. (Southern Research Inst., Birmingham, AL (USA)). Aug 1987. 234p. (SORI-EAS—1127). NTIS, PC A11/MF A01.

See also Volume 1, Part 2, PB—87-227294.

This report gives preliminary data on methodology for two groups of compounds: organometallics and other organic compounds difficult to measure by the generalized methods. Previous work (Contract 68-02-2685, Task 111, and Task 1 of this contract) involved the evaluation of generalized GC/FID, GC/MS, and HPLC/UV methods for determining approximately 170 compounds from the approximately 400 compounds in Appendix VIII, Part 261, 40 CFR. However, the survey analysis portion of waste characterization often targets specific compounds for determination in incinerator effluent that are not amenable to previously developed methods. Therefore current research involves the development of specific GC/FID, GC/MS, and HPLC/UV methods for the determination of several of these compounds. Organometallic compounds such as benzenearsonic acid, hydroxydimethylarsine oxide (cacodylic acid), phenylmercury acetate, selenourea, and tetraethyl lead were selected as candidate POHCs for this study. In support of the destruction and removal efficiency requirement, generalized GC/FID, GC/MS, and HPLC/UV analysis methods were evaluated and, when necessary, modified for the detemiination of 33 additional candidate POHCs.

1117 **New integrated air separation plant for the production of oxygen and steam.** Brown, W.R.; Cassano, A.A.; Dunbobbin, B.R.; Massey, R.G.; Leithe, H. (Air Products and Chemicals, Inc., Allentown, PA, USA; Department of Energy, Washington, DC, USA. Office of Industrial Programs; Air Products G.m.b.H., Duesseldorf, Germany, F.R.). *Stahl und Eisen;* 107: No. 17, 801-804(24 Aug 1987). (In German).

The utilization of low-cost waste heat for the production of oxygen in an integrated system was the aim of the air separation process described in the following. The process is based on the property of molten alkali nitrite of forming nitrate in a compressed atmosphere, which is decomposed then again into nitrite after heating and/or pressure reduction with the release of 99.8% oxygen. The available waste heat can be used for heating purposes. The process can be appropriately implemented in waste heat boilers of basic oxygen steelmaking plants, blast-furnace waste gas boilers as in all systems which are operating or producing waste heat and which require oxygen for their own operation. (orig./IHOE).

1118 **Recent developments concerning circulating bed combustion of spent potlinings.** Rickman, W.S.; Young, J.E. (Ogden Environmental Services, San Diego, CA). pp 659-662 of Light metals - 1987. Zabreznik, R.D. Warrendale, PA; The Metallurgical Society Inc. (1987). (CONF-870272—).

From American Institute of Metallurgical Engineers annual meeting: light metals session; Denver, CO, USA (22 Feb 1987).

The Aluminum Association (AA) and Ogden Environmental Services (OES) are developing circulating bed combustion (CBC) as a treatment method for spent potlinings - a product of aluminium smelter operations. Argonne National Laboratory (ANL) is a subcontractor to OES in the selection and laboratory-scale testing of a wide variety of process options. The overall goal is to solve environmental and economic problems for aluminum producers. The long-term program goals are to develop, design, construct, and operate spent potlining combustors at a cost that is competitive to landfills, but with none of the long-term liabilities. Process development work is scheduled for completion in 1986 with a process definition package issued by December 1986.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 298, 432, 436, 520, 531, 547, 662, 1009, 1029, 1523, 1794

1119 (ANL/CNSV-TM—173, pp 3-5) **Low-technology resource recovery: source separation.** Ridings, R.L. (City of Austin, TX). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

The city of Austin, Texas spends over 14 million dollars a year on solid waste services that include refuse collection and disposal, curbside recycling, dead animal service, street cleaning and litter control. The city has implemented a resource recovery plan to complement its solid waste disposal efforts. The resource recovery plan was designed to burn 600 tons of refuse producing 20 megawatts of electricity.

1120 (ANL/CNSV-TM—173, pp 66-81) **Thermochemical conversion of municipal waste: pyrolysis, gasification, and/or liquefaction.** Kuester, J.L. (Arizona State Univ., Tempe). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

The role of thermochemical pyrolysis, gasification and/or liquefaction systems for producing energy and chemical from municipal waste is presented. The primary virtue, as opposed to complete combustion routes, is the attainment of a more versatile, higher quality product. The primary drawback is a higher degree of processing sophistication. Technology options and considerations, the present status and future projections are discussed. 2 references, 2 figures, 2 tables.

1121 (ANL/CNSV-TM—173, pp 87-91) **Municipal-waste combustion: status of EPA programs.** Kellam, R.G. (Environmental Protection Agency, Research Triangle Park, NC). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

The regulatory activities that are underway within EPA to address the problems concerning municipal waste disposal are described. There are four: the proposed new source performance standard for industrial boilers; subtitled of the reauthorized Resource Conservation and Recovery Act (RCRA) which applies to non-hazardous landfills; section 102 of RCRA, obligating EPA to report to Congress on the extent and control of dioxin emissions from municipal waste combustors; and the assessment of hazardous air pollutants under section 112 of the Clean Air Act.

1122 (ANL/CNSV-TM—173, pp 95-104) **Resource-recovery facility development: steps to successful implementation.** Lewis, S.G. (Roy F. Weston, Inc., Burlington, MA). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

The steps for successful resource recovery project implementation are discussed. A resource recovery project normally can be planned to take about 5 years from its inception through completion of construction. First, you can plan your own steps for successful implementation if you know what is coming down the road. You can prepare yourself if you know what hurdles you will have to jump over in the process of developing a resource recovery facility. For this reason, the author will describe the four major hurdles, or tests, that your project must pass on its way to becoming successful. The point is that if you know what the tests are, you can study and plan how to pass them. The four tests are: The Community Acceptance Test; The Regulatory Test; The Political Test; and The Financial Test. Second, of all the phases in the resource recovery development process, he wants to focus on facility procurement, because the process is so different from any other procurement experienced, and because important decisions are made during procurement with which you must live for a very long time.

1123 (ANL/CNSV-TM—173, pp 105-123) **Resource recovery for municipalities in the southwest: major legal issues and their impacts.** Mishkin, A.E. (Beveridge & Diamond, P.C., Washington, DC). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

The legal framework for resource recovery reflects the novelty and unusual nature of these projects for municipalities. This paper provides an overview of significant legal issues relating to procurement, tax, financing, environmental regulation, and energy sale. It also describes a number of programs that favor or hinder the development of resource recovery. Emphasis is given to statutes and programs affecting the southwestern states. The paper also identifies interest groups affected by the legal issues, and the potential impacts of the issues on those groups. key legal issues should be studied early so that need state legislation can be identified and obtained on timely basis.

1124 (ANL/CNSV-TM—173, pp 124-141) **Finding markets and negotiating a successful project.** Gershman, H.W. (Gershman, Brickner & Bratton, Inc., Washington, DC). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

Locating and securing an energy market and completing successful contractual negotiations are two critical factors to timely, cost-effective facility implementation and operation. The success with which markets are developed from the start of project planning will be the key to their eventual involvement and the overall economic viability of any forthcoming project. This discussion addresses the necessary steps to establish a successful, long-term relationship with an energy and/or materials market. Also discussed wil be techniques used to negotiate contracts with a project's selected vend and to keep other important aspects of the development process going simultaneously. It must be remembered that local political support and leadership must be present during every phase of project development and an informed project sponsor is a vital asset to successful negotiations and project implementation.

1125 (ANL/CNSV-TM—173, pp 142-151) **Financing resource-recovery projects.** Atanasio, P. (Salomon Brothers, Inc., New York, NY). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

This paper has been prepared to provide an overview of some major issues involved in financing resource recovery facilities. Each subject discussed could provide a framework for its own detailed presentation and is beyond the scope, and in the intent, of this paper. Rather, its purpose is to prompt the developer of a project to further investigate the issues so as to better understand all of the relevant data involved in this rather complex area of municipal finance. The ultimate goal being to implement the most cost effective project to help solve one's waste disposal problem.

1126 (ANL/CNSV-TM—173, pp 174-179) **Waste-to-energy projects in Texas: selecting systems to meet permitting requirements.** Hendrickson, B.; Rodgers, B. (American Ref-Fuel Co., Houston, TX). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

In October 1984, American Ref-Fuel Company, a joint undertaking of Browning-Ferris Industries, Inc. and Air Products and Chemical, Inc. formed to market waste-to-energy plants, announced plans to build a 1500 ton per day mass burn, waste-to-energy facility in Pasadena, Texas. Since that time, work has continued on applications to secure the numerous permits required to build the facility. As of the data of this report, all required environmental permits except the air permit from the Texas Air Control Board have been received. The following discussion will describe the process followed to secure the two major permits for this project; which

are the Permit to Operate a Municipal Solid Waste Site from the Texas Department of Health (TDH) and the Permit to Construct, from the Texas Air Control Board (TACB).

1127 (ANL/CNSV-TM—173, pp 180-193) **Promise of resource recovery: lessons from the New York experience in gaining public approval.** Steisel, N. (Lazard Freres & Co., New York, NY). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

Faced with only 10-12 years of remaining disposal capacity New York City has mounted a comprehensive solid waste management program, involving in its first phase the construction of five waste-to-energy facilities to process over 40% of the City's waste and the implementation of a variety of materials recycling and reuse programs intended to increase recycling rates from 13% to 25%. In order to gain approval for the waste-to-energy component of the plan in the face of significant public controversy, the City conducted one of the most thorough public reviews of the environmental impact of these plants with special emphasis on the emissions of dioxin. This paper describes the process New York City followed to gain public approval for its projects and offers the central arguments in refutation of the four major arguments of resource recovery critics; to wit: dioxin is so toxic, human exposure should not be allowed; proponents seriously underestimate the risks of exposure because they employ overly optimistic plant emission data; proposed pollution control systems do no reduce emissions; and, viable, safer alternatives are available.

1128 (ANL/CNSV-TM—173, pp 197-200) **Management alternatives and how to choose one.** Funk, H.D. (Raintree Resource Recovery, Inc., Houston, TX). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

Resource recovery is a viable alternative for the disposal of solid waste for many communities. However, the process of how a governmental entity procures a resource recovery project can be complex. The purpose of this paper is to define the spectrum of management processes available for procuring resource recovery services and how to choose one, with a focus on the private sector role.

1129 (ANL/CNSV-TM—173, pp 203-205) **San Diego experience in resource recovery.** Clay, N.A. (County of San Diego, CA). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

San Diego's only landfill is receiving about 1.2 million tons/year or 4000 tons/day of trash. The SANDER facility is sized to take about 2250 tons/day so what about the other 1750 tons/day. An active recycling program is the answer to that question. Already San Diegan's are recycling newspaper and aluminum cans at a rate close to 40% to 50% through community buyback centers and volunteer organizations, such as churches and schools. The City has plans on the drawing board for a major buyback center at the landfill and is looking at a curbside recycling program for certain communities. A feasibility study for mechanical separation of raw garbage at the landfill has been completed and they have turned the results over to private industry for their input before issuing a request for proposal.

1130 (ANL/CNSV-TM—173, pp 206-211) **Tulsa resource-recovery project: from start to start-up.** Richmond, P. (Escambia County Sanitation Dept., Pensacola, FL). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

To deal with the problem of limited landfill space available for municipal waste disposal, the city of Tulsa began looking for a successful, cost effective resource recovery project. The authors discusses the problems encountered, the decisions that had to be made and the risks that were involved with the project.

1131 (ANL/CNSV-TM—173, pp 212) **Waste-to-energy facility: Cleburne, Texas.** Moss, L.E. (City of Cleburne, TX). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

Early in 1980 it became apparent that the City of Cleburne had a landfill that was quickly running out of room. At that time, the decisions was made to explore the alternative of incineration instead of beginning the pursuit of another landfill site. Today, the City of Cleburne has in operation a 115 ton per day modular waste-to-energy facility. The plant is capable of producing, 23,000 pounds of steam per hour and utilizing the steam to produce up to 860 kilowatts of electricity. Based upon hard numbers currently available, the cost for disposal, if the city were selling the steam to an industry and processing 100 tons per day of solid waste, would be approximately $14.00 per ton. As it is, with no steam sales, selling power to Texas Power and Light Company and only processing approximately 50 tons per day, the cost more nearly approximates $45.00 per ton. The vast majority of this cost is going for debt retirement. The community has been, and still is, committed to the incineration alternative. The authors task now is to find a steam customer, and increase the processed tonnage up to more nearly 100 per day.

1132 (PB—87-221297/XAB) **Development of a light-duty gas engine for cogeneration service. Annual report, March 1985-May 1986.** DiNanno, L.; Raymond, R. (TECOGEN, Inc., Waltham, MA (USA)). Aug 1986. 148p. (TE—4370-73-86). NTIS, PC A07/MF A01.

This report covers the first year's activities of a program undertaken to improve the performance and maintenance requirements of a light-duty gas engine for cogeneration service. The subject engine is a 454-cubic-inch displacement automotive gasoline engine converted to operate on natural gas. This engine is currently used in cogeneration applications. It is the object of the program to improve its performance, both in terms of output and efficiency, and to reduce its service requirements, thereby enhancing gas-fired cogeneration applications. Results of the first year's efforts indicate the potential for operating the engine at a rating of 75 kW (vs its 60 kW current rating) with an efficiency improvement of 8%. These improvements were achieved through camshaft optimization and increased compression ratio. A 75-kW engine is currently being endurance tested. Work on extension of the service interval is focused on the oil change interval. The effects of sump size, oil type, type of filtration, fuel/air ratio, etc. are reported.

1133 (PEIPUB—870108) **In the matter of the Public Utilities Commission Act and the Electric Power and Telephone Act, and in the matter of the application of Maritime Electric Company, Limited and Maritime Electric (P.E.I.) Limited for approval of a 1987 capital budget. Decision and order.** (Prince Edward Island Public Utilities Commission, Charlottetown (Canada)). 8 Jan 1987. 14p. Prince Edward Island Public Utilities Commission, 134 Kent St., PO Box 577, Confederation Court Bldg., Ste. 501, Charlottetown, P.E.I., Canada C1A 7L1; $N/C.

Approval was granted by the Public Utilities Commission to Maritime Electric Company, Limited and Maritime Electric (P.E.I.) Limited to proceed with capital expenditures in accordance with the capital budget for the year 1987. Budget breakdowns are included.

1134 (PEIPUB—870529) **In the matter of the Public Utilities Commission Act and the Electric Power and Telephone Act, and in the matter of an application of Maritime Electric Company, Limited and Maritime Electric (P.E.I.) Limited dated 19 January 1987. Phase I. Proceedings. Decision and order.** (Prince Edward Island Public Utilities Commission, Charlottetown (Canada)). 29 May 1987. 36p. Prince Edward Island Public Utilities Commission, 134 Kent St., PO Box 577, Confederation Court Bldg., Ste. 501, Charlottetown, Prince Edward Island, Canada C1A 7L1; $N/C.

Maritime Electric Company, Limited and Maritime Electric (P.E.I.) Limited were ordered by the Public Utilities Commission

to: adhere to assigned rate bases for 1984, 1985 and to maximum allowable rates of return for 1987, 1988; implement a revised schedule of depreciation rates; submit a revised schedule of basic rates. 5 tabs.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 1065

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

1135 (N—87-26692, pp 22) **Plasma motor generator system.** Hite, G.E. Jun 1987. NTIS, PC A16/MF A01. (NASA-CR—171984-VOL-1; NAS—1.26:171984-VOL-1).

In National Aeronautics and Space Administration (NASA)/ American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, Volume 1.

The significant potential advantages of a plasma motor generator system over conventional systems for the generation of electrical power and propulsion for spacecraft in low Earth orbits warrants its further investigation. The two main components of such a system are a long insulated wire and the plasma generating hollow cathodes needed to maintain electrical contact with the ionosphere. Results of preliminary theoretical and experimental investigations of this system are presented. The theoretical work involved the equilibrium configurations of the wire and the nature of small oscillation about these equilibrium positions. A particularly interesting result was that two different configurations are allowed when the current is above a critical value. Experimental investigations were made of the optimal starting and running conditions for the proposed, low current hollow cathodes. Although optimal ranges of temperature, argon pressure and discharge voltage were identified, start up became progressively more difficult. This supposed depletion or contamination of the emissive surface could be countered by the addition of new emissive material.

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 140, 141, 163, 165, 163, 174, 174, 175, 176, 177, 178, 255, 256, 471, 661, 1132

1136 **(AD-P—005547/5/XAB) Application of radiation physics and photogrammetric techniques for the diagnosis and solution of mechanical engineering problems and performance improvements in the development of aero gas turbine engines at Rolls Royce.** Stewart, P.A. (Rolls-Royce Ltd., Bristol (UK)). 1986. 19p. NTIS, PC A02/MF A01.

This article is from Advanced Instrumentation for Aero Engine Components: Conference Proceedings of the Propulsion and Energetics Panel Symposium (67th) Held in Philadelphia, Pennsylvania on 19-23 May 1986, AD-A182 954, p28-1-28-19.

High-energy (8 MeV) x rays are used to determine metal-component movements for engine-performance improvements and integrity confirmation, using film. Real-time video is used for transient events. Low-energy x rays with high-speed cine fluoroscopy were used to analyze molten-metal flows in the turbine-blade casting process. Cold neutrons and low-energy x rays were used to analyze two-phase flows and oil distribution in the Gem engine oil-scavenge system. Positron-emitting isotope techniques are being developed to determine fuel- and lubrication-system dynamics. The images captured by these systems are then processed by digital techniques and pattern recognition and cross correlation is carried out. Measurements are made from the film and video images using two- and three-dimensional photogrammetric methods.

1137 (CONF-8406364—Summs., pp 335-348) **Urban bus drive system concept 1990. Concepts and strategies.** Rattaj; Appel; Kuehnel; Graupmann; Wiedemann; Paulsen. (Institut fuer Aggregatetechnik und Verkehrsfahrzeuge G.m.b.H., IAV, Berlin, Germany, F.R.; Volkswagenwerk A.G., Wolfsburg, Germany, F.R.; Studiengesellschaft Nahverkehr m.b.H., SNV, Berlin, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

A new drive-system concept is planned for implementation in a standard urban transit bus. This drive system will feature the following characteristics: instead of a large engine two small diesel engines with the same total power are used; fuel savings by virtue of variation in swept volume; elimination of noise and pollution emissions in the area of bus stops by means of automatically switching the motors on and off; definite reduction in emission of soot and particles during cruising operation; utilization of series-production components; improvement in the power-to-weight ratio. A report is made on the initial results of theoretical preliminary investigations in the following areas: analysis of drive-system possibilities; electronic-control philosophy of the drive system; computer simulation of driving operations.

1138 (DOE/METC—87/6077, pp 31-43) **GE gas turbine overview.** Ekstedt, E.E.; Singleton, J.L.; Kimura, S.G.; Long, J. (General Electric Co., Cincinnati, OH). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23168.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The overall objective of the Advanced Coal Fueled Gas Turbine Systems Program is to develop the technological basis necessary for subsequent commercial development of a direct fired coal fueled gas turbine power system. The system concept for this program uses an LM500 advanced aero-derivative gas turbine engine designed for direct firing of coal fuel. This system can be used in transportation and small stationary power applications. Components and systems required to achieve this objective in a cost effective and environmentally sound manner will be developed. The coal fueled gas turbine components developed will be fabricated and incorporated into an LM500 gas generator for integrated system testing with the coal fuel. The paper describes both the angular and cylindrical combustor development; environmental control of sulfur, particulates, NO/sub x/, and unburned hydrocarbons; procedures for systems testing and analysis. 7 references, 7 figures, 2 tables.

1139 (DOE/METC—87/6077, pp 67-80) **Coal fueled diesel systems research.** Leonard, G.; Fiske, G.; Giles, W.; Kimura, E.; Mehan, R.; Spiro, C.; Fischer, R.; Hapeman, M.; Hsu, B.; Flynn, P. (General Electric Corp. Research and Development, Schenectady, NY). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-85MC22181.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The program objective is to evaluate the technical feasibility and economic reality of a coal-fueled diesel power locomotive. The technical feasibility is being examined by the use of experiments designed to determine practical concepts for the high-pressure injection of coal water mixtures; the effect of combustor design and coal fuel variables on the combustion characteristics of coal water mixture (CWM); screening of erosion and wear resistant materials; and preliminary assessment of coal fueled diesel emissions issues. After describing the project more fully, an economic assessment is made of coal burning locomotives. The present design of diesel electric locomotives is the base against which all alternatives were judged. Five coal-fired options were considered: coal fired diesel; direct burning gas turbine, with and without steam injection; gasified coal burning gas turbine; and steam turbine. 8 references, 1 figure, 4 tables.

1140 (DOE/METC—87/6077, pp 81-90) **GM diesel overview.** Koch, R.L.; Williams, H.A. Jr.; Ryan, T.W. III; Kamo, R. (General Motors Corp., Indianapolis, IN). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-85MC22123.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The overall objective of the program is to investigate the economic characteristics and technical features for a coal-fueled diesel system. Commercialization merits of coal-fueled locomotives

have been examined and reported previously in the program. Bench scale and full scale tests have been conducted to determine the effects of selected coal fuels on fuel storage, handling, injection, ignition, combustion and engine wear. Additional objectives includes coal fueled diesel emissions evaluations and determination of economic and technical merits of coal-fueled locomotives with prime mover engines other than coal-fueled diesel engines. Preliminary investigation of engine durability problems and possible solutions is also a current objective. This paper discusses results from the economic application assessment and from preliminary testing. 7 references, 6 figures, 3 tables.

1141 (DOE/METC—87/6077, pp 145-149) **Assessment of twelve coal-fired locomotive concepts.** Liddle, S.G. (Koh Systems, Inc., Rockville, MD). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-85MC22012.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objective of this study is to evaluate the performance and life-cycle cost of twelve coal-fired locomotive concepts so as to assess their relative suitability for use by the American railroads. The study consists of three major phases: locomotive performance, life-cycle cost, and market size. Each concept consists of three main parts: an engine, a combustor, and a fuel. The twelve concepts are: 1) Direct Drive Steam Piston, fixed bed, nut coal; 2) Four Stroke Diesel, stirred bed gasifier, stoker coal; 3) Steam Turbine, fixed bed, nut coal; 4) Electric Drive Steam Piston, fluidized bed, granulated coal; 5) Open Cycle Gas Turbine, fluidized bed, coal/water slurry; 6) Open Cycle Gas Turbine, open chamber, powdered coal; 7) Four Stroke Diesel, piston-cylinder, powdered coal; 8) Open Cycle Gas Turbine, open chamber, coal/water slurry; 9) Stirling Engine, open chamber, powdered coal; 10) Four Stroke Diesel, piston-cylinder, coal distillate; 11) Molten Carb. Fuel Cell, entrained bed gasifier, pulverized coal; and 12) Fully Adiabatic Diesel, piston-cylinder, powdered coal. The basis for comparison to the present Diesel-electric locomotive is concept 10 using petroleum based Diesel No. 2 fuel. Results on efficiency and heavy duty cycle fuel usage are given. 1 reference, 3 tables.

1142 (DOE/METC—87/6077, pp 190-196) **Performance and emissions of coal-fueled engines using group combustion theory.** Caton, J.A.; Annamalai, C.K. (Texas A & M Univ., College Station). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23256.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The objectives of this project are: to formulate a non-steady group evaporation and combustion model for coal slurry fuels for diesel engine conditions; to formulate the detailed engine heat transfer and pollutant formation models; to integrate the group combustion, heat transfer, and pollutant formation models into the coal-fueled engine cycle simulations; to verify the cycle simulation results by comparing to experimental data from the literature; to use the completed cycle simulation to investigate the details of coal fuels ignition and combustion in diesel engines; to use the completed cycle simulation to examine overall engine performance and emissions as a function of engine parameters such as engine speed, engine load, injection timing and injection duration; to use the completed cycle simulation to study overall engine performance and emissions as a function of fuel parameters such as coal loadings, particle sizes, and volatile content; and to use the completed cycle simulation to evaluate overall engine performance and emissions for low-heat-rejection (adiabatic) engines. Results to date are given. 9 references, 4 figures.

1143 (DOE/METC—87/6077, pp 298-310) **Combustor tests.** Wilkes, C.; Gonzalez, D.E.; Razdan, M.K.; Santanam, C.B. (General Motors Corp., Indianapolis, IN). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-86MC23165.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The overall objective of this contract is to perform a proof of concept demonstration run of 50 hours duration on a modified Allison industrial gas turbine operating on coal fuel. A major portion of the funding for this contract is applied to the development of a combustion system that is capable of burning coal fuel. The main objective for this portion of the program is to develop a combustor that is capable of burning coal with maximum efficiency, minimum ash carry-over and to do so in an environmentally acceptable manner. This report describes the progress made during the initial design phase, fabrication and assembly of the bench scale system, and the preparation made for initial testing. 6 references, 6 figures, 2 tables.

1144 (DOE/METC—87/6077, pp 311-324) **Gas turbine component screening program: fuel flexible combustor.** Cowell, L.H.; White, D.J. (Solar Turbines Inc., San Diego, CA). Apr 1987. NTIS, PC A21/MF A01. Order Number DE87001072/JAW. (CONF-8704135—). Contract AC21-84MC21284.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The overall objective of this program was to move into the next phase of the two stage slagging combustor (TSSC) evaluation using the data and information from Solar's earlier combustor program. The specific objectives were: (1) to gain an understanding of combustion requirements and mechanisms as a function of the combustor design and the physical properties of coal-derived fuels, and (2) to characterize the products of combustion from the TSSC and gain an understanding of their potential effects on gas turbine hot end components. An improved larger-sized TSSC was designed, built and tested. Three different primary zone geometries and three coal-water mixture fuels were tested. In addition one test run was made using dry pulverized coal and an improved dry coal feed system which corrected feed problems encountered in the previous program. Results are discussed. 3 references, 15 figures, 1 table.

1145 (DOE/NASA—0167-11) **Advanced Gas Turbine (AGT) technology development project: 1986 annual report.** (Garrett Turbine Engine Co., Phoenix, AZ (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Feb 1987. 131p. (NASA-CR—180818). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88001615/JAW.

This report describes work performed to develop technology for an Advanced Gas Turbine (AGT) with automotive applications. Three engines have been built and tested. During this reporting period, one engine was operated to measure the heat transfer coefficients in the engine flowpath. The engine was also used as a proof test bed for ceramic turbine rotors. A second engine was tested to evaluate the regenerator drive system. Information was also gained regarding rotor integrity during the course of this testing. A third engine was built in the all ceramic configuration and tested at 2000°F at 70 percent speed. 12 refs., 122 figs., 25 tabs.

1146 (EUR—10733-DE) **Development, construction and testing of a novel internal combustion engine with conical rotating slide valve.** (Firma Ficht G.m.b.H., Kirchseeon (Germany, F.R.)). 1986. 44p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900071/JAW.

Four different multi-cylinder two-stroke engines of a new design ranging from 100 cc. to 200 cc. in capacity and with different power outputs, have been developed and have successfully completed trials. The trials proved that this type of engine has many advantages over conventional design. The distinctive features of this engine are its rigidly connected pistons, the seals between the base of the cylinders and the crankcase, and the slotted linkage system to convert the reciprocating motion of the pistons into the rotary motion of the crankshaft. The expected advantages are a very high power-to-weight ratio, reduced mechanical losses which provide an extended working life and reduced fuel consumption with low pollution. The design and construction of the basic-cooled two-cylinder unit has been completed. Experimental measurements confirm theoretical predictions. Measurements in the power range of 3.3 kW to 9.2 kW have been made. The minimum fuel consumption was found to be 200 gr of fuel per HPh to 1700 rpm.

1147 **(EUR—10812-EN) The development and evaluation of three-dimensional models of cold flow in internal combustion engines: Final summary report, 1 March 1983-31 December 1984.** (BL Technology Ltd., Warwick (UK)). 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900077/JAW.

This report describes the first phase of a programme aimed at developing a series of computer models capable of describing the air flow and turbulence in cylinders of internal combustion engines. During the course of this first phase programme a computer code has been developed which is capable of simulating the flow and turbulence field within a limited but useful range of chamber geometries. The Computer code allows for the description of simple cylinder head recesses and offset bowl-in-pistons along with two possible representations of valves. Velocity and turbulence measurements have been made using laser doppler anemometry on plexiglass engines for code evaluation. Flow measurements at the valve have been made to establish inlet conditions for steady and unsteady flows and in-cylinder data acquired for a range of chamber geometries. 1 ref., 3 figs.

1148 **(ORNL/TM—10469) Ceramic technology for advanced heat engines project: Semiannual progress report, October 1986-March 1987.** (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 428p. NTIS, PC A19/MF A01; 1; GPO Dep. Order Number DE88001520/JAW.

This report contains four subelements: (1) Monolithics, (2) Ceramic Composites, (3) Thermal and Wear Coatings, and (4) Joining. Ceramic research conducted within the Monolithics subelement currently includes work activities on green state ceramic fabrication, characterization, and densification and on structural, mechanical, and physical properties of these ceramics. Research conducted within the Ceramic Composites subelement currently includes silicon carbide and oxide-based composites, which, in addition to the work activities cited for Monolithics, include fiber synthesis and characterization. Research conducted in the Thermal and Wear Coatings subelement is currently limited to oxide-base coatings and involves coating synthesis, characterization, and determination of the mechanical and physical properties of the coatings. Research conducted in the Joining subelement currently includes studies of processes to produce strong stable joints between zirconia ceramics and iron-base alloys. A major objective of the research in the Materials and Processing project element is to systematically advance the understanding of the relationships between ceramic raw materials such as powders and reactant gases, the processing variables involved in producing the ceramic materials, and the resultant microstructures and physical and mechanical properties of the ceramic materials. Success in meeting this objective will provide US companies with new or improved ways for producing economical highly reliable ceramic components for advanced heat engines.

1149 **Direct brazing of ceramics for advanced heavy-duty diesels.** Moorehead, A.J.; Keating, H. (Oak Ridge National Lab., Ceramic Technology Group, Metals and Ceramics Div., Oak Ridge, TN). *Welding Journal (Miami);* **65**: No. 10, 17-32(Oct 1986).

Although monolithic ceramic materials have been widely used in the past in nonstructural applications - such as electrical insulators, crucibles, microwave windows, and pump and valve components for the chemical industry - it has been only in recent times that major efforts have been made to use ceramics in structural applications where significant tensile or multiaxial stresses are imposed over a range of temperatures. The major impetus for most of this interest over the past decade is economics; as fuel costs have increased, so has the need for increasing efficiency in a multitude of energy-conversion processes. Ceramic materials show considerable promise for use in advanced engines. The desire to increase engine efficiency and performance has led to continuing improvements in material-use temperatures. A number of automotive manufacturers are working to develop a more efficient diesel engine for cars or trucks that eliminates the need for power-consuming cooling requirements by using structural ceramics in the combustion chamber - i.e. cylinder, piston cap, and valve plate. There is also interest in ceramics as wear pads attached to such components as valve rocker arms and push rods. The use of petroleum materials could be reduced even further through use of high-temperature ceramic bearings and solid lubricants.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 1176

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 934, 1063, 1091

1150 **(CONF-8406364—Summs., pp 327-334) Applications and marketing potential of battery-driven electric passenger cars.** Meetz. (Studiengesellschaft Nahverkehr m.b.H., SNV, Hamburg, Germany, F.R.; Studiengesellschaft Nahverkehr m.b.H., SNV, Berlin, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A21. Order Number DE87753276/JAW.

From 11. status seminar: research on short-distance transportation; Berlin, F.R. Germany (27 Jun 1984).

The traffic and transportation sector, almost entirely dependent on oil, must make use of every opportunity to economize on oil consumption and find petroleum substitutes. One possibility for substituting oil in the transportation sector is the use of battery-powered electric passenger cars. Because this would also lead to reduced exhaust pollution and noise molestation this can also serve the aims of environment protection. In this paper based on an investigation sponsored by the Federal Minister of Transport the potential applications and realizable market potential of battery-powered electric passenger cars have been estimated. The resulting market chances have been derived. The result is, that at present there are no realistic prospects for the battery-powered electric passenger car in todays market. Extending the regarded period up to 1995 the prospects of batterypowered vehicles will increase. However not more than two manufacturers should gain considerable proportions of the market. Otherwise, due to small production figures per manufacturer, the price for such cars would be too high.

1151 **(NMRDI—2-74-4610) Performance monitoring and analysis of electric van fleet vehicles: Final technical report.** Lechner, T.M. (Public Service Co. of New Mexico, Albuquerque (USA)). Sep 1987. 111p. NTIS, PC A06/MF A01 - NMRDI, 457 Washington SE, Albuquerque, NM 87108. Order Number DE88900066/JAW.

This report documents efforts of various organizations, working in concert, to improve on, produce, demonstrate, and commercialize a viable electric vehicle (EV) for fleet applications. In addition, it compares current EV technology to its compressed natural gas and gasoline counterparts. The report also assesses the potential impact of wide-scale EV commercialization on the state. The concept of using electricity to power vehicles for commercial or private transportation needs is not new. Back in the early 1900s EVs enjoyed wide popularity. Vast oil discoveries, cheap gasoline, and improvements in internal combustion engine technologies undermined EV popularity over a relatively short time period. A serious reconsideration of EV technology began in the late 1970s when it became apparent that the world, and the US in particular, was not assured an endless supply of cheap petroleum fuels. 7 refs., 12 figs., 16 tabs.

1152 **(TVA/PUB—87/20) Nickel-iron EV battery application workshop: Summary report.** Douglas, D.L. (Douglas (David L.), Inc., Bloomington, MN (USA); Electric Power Research Inst., Palo Alto, CA (USA); Tennessee Valley Authority, Chattanooga (USA)). Jun 1987. 9p. (RP—2415-4-Summ.; CONF-8705197—Summ.). NTIS, PC A02/MF A01. Order Number DE88900018/JAW.

From Nickel-iron electric vehicle battery applications workshop; Chattanooga, TN, USA (27 May 1987).

There is a consensus that the nickel-iron system is the only one, other than the lead-acid, which has been developed and tested to the point where its introduction into a fleet of EVs may be practical. A workshop, the objective of which was to address this narrow issue only, was held on May 27 and 28, 1987. The goal of

the workshop was to provide the information on which EPRI and EVDC can base a judgment as to whether to recommend the procurement by the utility industry, for evaluation in their own or customer fleets, of a significant number of nickel-iron battery-powered electric vans. The utility EV program is directed toward the commercialization of electric vans in the very near future; accordingly, the EVs to be procured must be production prototypes and not engineering experiments. As a practical matter, the propulsion systems must be those on test today at various locations. Accordingly, the workshop agenda was structured to focus on available nickel-iron EV batteries. In this report, the status of the nickel-iron EV battery as reported in the workshop deliberations is described under headings relating to important attributes of performance/capability. 4 tabs.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 1090

3307 Emission Control

REFER ALSO TO CITATION(S) 227, 228, 661, 1727, 1738

35 ARMS CONTROL

1153 **(AD-A—183000/9/XAB) Strategic Defense Initiative Demonstration/Validation program environmental assessments summary.** Brown, G. (Strategic Defense Initiative Organization, Washington, DC (USA). Systems Engineering). Aug 1987. 155p. NTIS, PC E02/MF A01.

The Strategic Defense Initiative Organization (SDIO) and its proponents (the U.S. Army and U.S. Air Force) plan to conduct Demonstration/Validation tests of the six technologies to demonstrate their respective ability to perform their required tasks, and to validate the requirements to determine their feasibility for a future decision on whether to proceed with Full-Scale Development. Demonstration/Validation tests would be conducted at 14 government facilities across the United States and the Republic of the Marshall Islands, and at contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document summarizes the findings expressed in the six Environmental Assessments for Demonstration/Validation testing of the individual technologies, and analyzes the potential cumulative environmental consequences of testing of multiple technologies at a given facility. In the event that any other technology is ready for entry into Demonstration/Validation at a later date, an Environmental Assessment will be prepared for that technology and this summary will be updated.

1154 **(AD-A—183001/7/XAB) Strategic Defense Initiative Demonstration/Validation program environmental assessment. Boost surveillance and tracking system (BSTS).** Brown, G. (Strategic Defense Initiative Organization, Washington, DC (USA). Systems Engineering). Aug 1987. 55p. NTIS, PC E02/MF A01.

The Strategic Defense Initiative Organization (SDIO) and one of its proponents (U.S. Air Force) plan to conduct Demonstration/Validation tests of the BSTS technology. These tests will demonstrate the ability of the technology to perform required tasks, and will validate a future decision on whether to proceed with Full-Scale Development. Demonstration/Validation tests would be conducted at the National Test facility, Cape Canaveral Air Force Station/Eastern Test Range, and at contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document addresses the potential environmental consequences of the Demonstration/ Validation testing of the BSTS technology.

1155 **(AD-A—183002/5/XAB) Strategic Defense Initiative Demonstration/Validation program environmental assessment. Space-based surveillance and tracking system (SSTS).** Brown, G. (Strategic Defense Initiative Organization, Washington, DC (USA). Systems Engineering). Aug 1987. 89p. NTIS, PC A05/MF A01.

The Strategic Defense Initiative Organization (SDIO) and its proponents (the U.S. Army and the U.S. Air Force) plan to conduct Demonstration/Validation tests of the SSTS technology. These tests will demonstrate the ability of the technology to perform required tasks, and will validate a future decision on whether to proceed with Full-Scale Development. Demonstration/Validation tests would be conducted at the Arnold Engineering Development Center, Nevada Test Site, Vandenburg Air Force Base/Western Test Range, Cape Canaveral Air Force Station/Eastern Test Range, Kennedy Space Center, National Test Facility, and at contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document addresses the potential environmental consequences of the Demonstration/Validation testing of the SSTS technology.

1156 **(AD-A—183003/3/XAB) Strategic Defense Initiative Demonstration/Validation program environmental assessment. Ground-based surveillance and tracking system (GSTS).** Brown, G. (Strategic Defense Initiative Organization, Washington, DC (USA). Systems Engineering). Aug 1987. 84p. NTIS, PC E02/MF A01.

The Strategic Defense Initiative Organization (SDIO) and its proponents (the U.S. Army and the U.S. Air Force) plan to conduct Demonstration/Validation tests of the GSTS technology. These tests will demonstrate the ability of the technology. These tests will demonstrate the ability of the technology to perform required tasks, and to validate production feasibility in support of a future decision on whether to proceed with Full-Scale Development. Demonstration/Validation tests would be conducted at the Nevada Test Site, National Test Facility, Vandenberg Air Force Base/Western Test Range, U.S. Army Kwajalein Atoll, and contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document addresses the potential environment consequences of the Demonstration/Validation testing of the GSTS technology.

1157 **(AD-A—183004/1/XAB) Strategic Defense Initiative Demonstration/Validation program environmental assessment. Space-based interceptor (SBI).** Brown, G. (Strategic Defense Initiative Organization, Washington, DC (USA). Systems Engineering). Aug 1987. 81p. NTIS, PC E02/MF A01.

The Strategic Defense Initiative Organization (SDIO) and its proponents (the U.S. Army and the U.S. Air Force) plan to conduct Demonstration/Validation tests of the SBI technology. These tests will demonstrate the ability of the technology to perform the required tasks, and validate a future decision on whether to proceed with Full-Scale Development. Demonstration/Validation tests would be conducted at Eglin Air Force Base, Edwards Air Force Base, U.S. Army Kwajalein Atoll, National Test Facility, and contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document addresses the potential environmental consequences of the Demonstration/Validation testing of the SBI technology.

1158 **(AD-A—183005/8/XAB) Strategic Defense Initiative Demonstration/Validation program environmental assessment. Exoatmospheric reentry vehicle interception system (ERIS).** Brown, G. (Strategic Defense Initiative Organization, Washington, DC (USA). Systems Engineering). Aug 1987. 109p. NTIS, PC E02/MF A01.

The Strategic Defense Initiative Organization (SDIO) and its proponents (the U.S. Army and the U.S. Air Force) plan to conduct Demonstration/Validation tests of the ERIS technology. These tests will demonstrate the ability of the technology to perform the required tasks, and validate a future decision whether to proceed with Full-Scale Development. Demonstration/Validation tests would be conducted at the Arnold Engineering Development Center, National Test Facility, Nevada Test Site, Harry Diamond Laboratories, Vandenberg Air Force Base/Western Test Range, U.S. Army Kwajalein Atoll, U.S. Naval Pacific Missile Range at Barking Sands, and contractor facilities. Tests would include analyses, simulations, component/assembly tests, and flight tests. This document addresses the potential environmental consequences of the Demonstration/Validation testing of the ERIS technology.

1159 **(AD-A—183006/6/XAB) Strategic Defense Initiative Demonstration/Validation program environmental assessment. Battle management/command, control, and communications (BM/C3).** Brown, G. (Strategic Defense Initiative Organization, Washington, DC (USA). Systems Engineering). Aug 1987. 76p. NTIS, PC E02/MF A01.

The Strategic Defense Initiative Organization (SDIO) and its proponents (U.S. Army and U.S. Air Force) plan to conduct Demonstration/Validation tests of the BM/C3 technology. These tests will demonstrate the ability of the technology to perform the required tasks, and will validate a future decision on whether to proceed with Full-Scale Development. Demonstration/Validation tests would be conducted at the Advanced Research Center, Electronic Systems Division, National Test Facility, Rome Air Development Center, Nevada Test Site, Harry Diamond Laboratories, and at contractor facilities. Tests would include analyses, simulations, and component/assembly tests. This document addresses the potential environmental consequences of the Demonstration/Validation testing of the BM/C3 technology.

3503 Verification

REFER ALSO TO CITATION(S) 1996

36 MATERIALS

REFER ALSO TO CITATION(S) 1, 1553, 2485

1160 **(DOE/ER—0348) Materials sciences programs: Fiscal Year 1987.** (USDOE Office of Energy Research, Washington, DC. Office of Basic Energy Sciences). Sep 1987. 297p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88000672/JAW.

Purpose of this report is to provide a convenient compilation and index of the DOE Materials Sciences Division programs. This compilation is primarily intended for use by administrators, managers, and scientists to help coordinate research. The report is divided into seven sections. Section A contains all Laboratory projects, Section B has all contract research projects, Section C has projects funded under the Small Business Innovation Research Program, Sections D and E have information on DOE collaborative research centers, gives distribution of funding, and Section G has various indexes.

1161 **(LBL—22010) Materials and Molecular Research Division: Annual report, 1986.** Phillips, N.E.; Muller, R.H.; Peterson, C.V. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 303p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88000674/JAW.

Research activities are reported under the following headings: materials sciences, chemical sciences, nuclear sciences, fossil energy, energy storage systems, and work for others. (DLC)

1162 **(PNL-SA—14533) Materials science and engineering needs in the energy industry: Geothermal industry.** Shannon, D.W. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76RL01830. 23p. (CONF-870192—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000099/JAW.

From Conference on research opportunities; Washington, DC, USA (22 Jan 1987).

The energy industry is a conservative industry that relies on conventional materials (steels, nickel-base alloys, concrete for the most part). We see this trend continuing, at least to 2000, with the traditional energy sources, coal, oil, gas and nuclear dominating the energy mix. The emphasis is now and will continue to be on evolutionary material reliability improvements through improved refining, fabrication, and maintenance. An understanding of life-limiting processes in service and associated condition monitoring developments will lead to life extension of the current classes of structural materials. New materials will therefore be introduced, primarily, into the new energy systems (solar, advanced coal, fusion, etc.) beyond 2000. These trends are reflected in the individual sections on the energy sources.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 212, 309, 310, 311, 326, 334, 387, 391, 480, 663, 684, 685, 685, 686, 686, 686, 688, 697, 761, 762, 768, 769, 771, 772, 909, 931, 1270, 1428, 1432, 1432, 1435, 1436, 1436, 1494, 1583, 1583, 2477, 2501, 2505, 2601, 2601, 2609

1163 **(AD-A—183054/6/XAB) Interdisciplinary approach to predictive modeling of structural adhesive bonding, chromic acid anodized Ti-6Al-4V: its characterization and its single lap bond strength to heat-resistant adhesives. Summary report, January 1982-June 1987.** Skiles, J.A.; Wightman, J.P. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Center for Adhesion Science). Jun 1987. 392p. (CAS/CHEM—87-2). NTIS, PC A17/MF A01.

Anodized titanium-aluminum-vanadium adhesive bonds exhibit improved corrosion resistance and a higher strength-to-weight ratio compared to conventional metal-bonding techniques for primary and/or secondary structural applications. This work was conducted to identify chromic acid (CA) anodization and bond process conditions that produced durable, structural applications. This work was conducted to identify chromic acid (CA) anodization and bond process conditions which produced durable, structural anodized titanium-aluminum-vanadium single lap bonds and to understand why these conditions were necessary. Heat-resistant adhesives tested had reported service temperatures greater than 423K, and were: polysulfone; polyethersulfone;polyphenylquinoxaline; polyetherimide, both unfilled and 20% glass filled; and 50% calcium-carbonate-filled polyimide. Hydrofluoric acid (HF) added to the CA anodization solution was necessary to produce structural bonds. Chromic acid hydrogen fluoride oxide was more porous, and thicker than the CA anodic oxide perhaps promoting physical and oxide/adhesive interphase mechanical interlock.

1164 **(AERE-R—12379) Theoretical evaluation of the consequences of microbiological activity on the corrosion of carbon steel overpacks.** Duddridge, J. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Engineering Div.). Dec 1986. 48p. H.M. Stationery Office, London, price Pound 5.00.

The report presents a speculative assessment of the consequences of microbiological activity on the corrosion behaviour of carbon steel overpack containers placed in granitic or argillaceous repository formations. Our knowledge of the microbiology of deep geological formations and groundwaters of relevance to nuclear waste disposal is briefly reviewed. Moreover, the environmental conditions likely to limit the continued survival and growth of those organisms identified as presenting a corrosion risk are discussed.

1165 **(BNL—40261) Disclinations: The magnetism and the magnetic anisotropies of the rare earth-3d transition metal hard magnets.** Watson, R.E.; Bennett, L.H.; Melamud, M. (Brookhaven National Lab., Upton, NY (USA); National Bureau of Standards, Washington, DC (USA); Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1987. Contract AC02-76CH00016. 14p. (CONF-871126—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001339/JAW.

From 32. conference on magnetism and magnetic materials; Chicago, IL, USA (9 Nov 1987).

An important class of hard magnets, involving rare earth and 3d transition metals and sometimes metalloids, includes $Nd_2Fe_{14}B$ and Nd_2Fe_{17}. We have noted a correlation between the local site magnetism in these two compounds and whether those sites lie on nets of so called major ligand lines or disclinations, i.e., bond lines shared by six common nearest neighbors. We have proposed that a criterion for choosing candidate alloys with strong 3d moments is the occurrence of such disclination nets, and using this criterion, have listed several structures having 3d sites with this characteristic. We have also rationalized the crystal field anisotropies as relating to the orientation of the major ligand lines. 7 refs., 1 fig., 2 tabs.

1166 **(CONF-870272—9) Non-lattice matched metallic superlattices.** Schuller, I.K.; Grimsditch, M. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02. Order Number DE87011512/JAW.

From American Institute of Metallurgical Engineers annual meeting: light metals session; Denver, CO, USA (22 Feb 1987).

High quality multilayers can be grown by sputtering and molecular beam epitaxy techniques. If the constituents are not lattice matched and do not form solid solutions, the reasons for the growth into superlattices is not understood. For some limited cases (Mo/Ni, Nb/Cu, V/Ni, Ag/Co) high quality superlattices can be grown quite easily, although the in plane structure is polycrystalline. If the constituents form solid solutions and are lattice matched the growth into single crystalline superlattices is possible, although more interdiffusion is likely. The physical properties in nonlattice matched superlattices exhibit anomalous elastic constants and a metal-nonmetal transition in their normal state properties. By changing the relative coupling across a normal material we have observed dimensional crossover in superconducting superlattices and the development of magnon bands in magnetic superlattices. 27 refs., 9 figs.

1167 **(CONF-870981—2) Welding and weldability of ductile intermetallic alloys.** David, S.A.; Santella, M.L.; Goodwin, G.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014061/JAW.

From Annual North American welding research seminar; Columbus, OH, USA (29 Sep 1987).

Successful welds have been produced in several nickel aluminide (Ni_3Al) alloys. Weldability has been found to be a strong function of boron, other alloying additions, and welding speed. Cracking during welding observed in some of the aluminides was predominantly in the heat-affected zone (HAZ) and was always intergranular. Additions of iron promote the formation of a second phase. The observed HAZ cracking in some of these alloys resulted from thermal stresses imposed on this region of the weldment at elevated temperature and from grain boundary weakness. Sound welds were produced in sheets of $(Fe,Ni)_3(V,Ti)$ and $(Fe,Co)_3(V,Ti)$ ordered alloys. Welds of $(Fe,Ni)_3(V,Ti)$ were disordered, but the tensile properties were not adversely affected. A reordering heat treatment restored the weldment properties to those of the base metal. Welds of $(Fe,Co)_3(V,Ti)$ remained ordered after the weld thermal cycle. Factors that seem to influence the weldment properties include ordered domain size and precipitation of carbide. 23 refs., 8 figs., 24 tabs.

1168 **(CONF-870992—1) Analysis at the atomic level: The atom probe field-ion microscope.** Miller, M.K. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000572/JAW.

From Accuracy in trace analysis: accomplishments, goals and challenges; Gaithersburg, MD, USA (28 Sep 1987).

The atom probe field-ion microscope (APFIM) is a unique analytical instrument that can analyze metals and semiconducting materials on the atomic scale. In recent years, the atom probe has developed into one of the most powerful instruments available for routine microstructural and microchemical analysis of materials. The types of investigations that have been performed have encompassed many diverse metallurgical subjects including phase transformations, segregation, diffusion, catalysis, and radiation damage. 3 refs., 3 figs.

1169 **(CONF-871207—11) The aging behavior of types 308 and 308CRE stainless steels and its effect on mechanical properties.** Vitek, J.M.; David, S.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87012541/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Aging of 308 and 308CRE SS was studied at 475 to 850°C for aging times up to 10,000 hours. Above 550°C, aging of 308 steel resulted in precipitation of carbides and the transformation of ferrite to sigma phase or the formation of sigma phase in initially ferrite-free material. The elevated-temperature aging of 308CRE steel resulted in the precipitation of titanium-rich carbides, nitrides, and sulfides, and the transformation of ferrite to sigma phase. The distribution of precipitates was affected by the initial condition of the materials. The elevated-temperature creep properties, and in particular the improved properties of 308CRE, were related to the precipitate distribution. Below 550°C, aging of welded type 308 steel, precipitation of G-phase within the ferrite was observed, as well as the decomposition of ferrite into alpha and alpha prime. With the help of a novel mechanical properties microprobe, which was capable of determining the hardness of the minor constituent ferrite phase, the hardness behavior as a function of aging could be related to the microstructures. These results are interpreted in terms of the potential susceptibility of these alloys to 475°C embrittlement.

1170 **(CONF-8110372—1) Surviving defect fraction in 14-MeV neutron-irradiated copper.** Zinkle, S.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000336/JAW.

From ICFRM-3: international conference on fusion reactor materials; Karlsruhe, F.R. Germany (7 Oct 1981).

The fraction of Frenkel defects that survive in isolated or clustered form during room temperature irradiation of copper has been measured as a function of fluence by a combination of electron microscopy (TEM) and electrical resistivity methods. Both methods indicate that the ratio of surviving to created defects decreased from 12 to 4.7% as the fluence of 14-MeV neutrons increased from 1×10^{20} to 2.9×10^{21} n/m^2. 7 refs., 2 figs., 4 tabs.

1171 **(CONF-8708104—2) Radiation induced collapse of the crystalline structure.** Pedraza, D.F. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014407/JAW.

From Conference on solid state amorphizing transformation; Los Alamos, NM, USA (10 Aug 1987).

A theory of irradiation-induced amorphization of ordered intermetallic compounds, based on the destabilization of the crystalline structure by excess defect accumulation, has been developed recently. The theory is reviewed starting with its phenomenological basis, where the microstructural evolution of intermetallic compounds that are turned amorphous by irradiation is emphasized. Next, the analysis of defect buildup that suggests the formation of a stable complex defect consisting of a vacancy-interstitial pair, called a complex, is reviewed. The possibility of a radiation induced microstructure such as interstitial clusters, in addition to complexes, in intermetallics that undergo the crystalline-to-amorphous transition is incorporated into the theory. A comparison of radiation effects in NiTi and in Zr_3Al is made using a rate theory approach. In the case of the aluminide, it is found that cluster development can hinder the amorphous transition when the material is irradiated with electrons. On the other hand, enhancement of complex production in the collision cascade, explains the occurrence of the transition during ion bombardment. 15 refs., 2 figs., 1 tab.

1172 **(CONF-8710123—2) Some stochastic aspects of intergranular creep cavitation.** Fariborz, S.J.; Farris, J.P.; Harlow, D.G.; Delph, T.J. (Lehigh Univ., Bethlehem, PA (USA)). Oct 1987. Contract FG02-84ER45088. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000065/JAW.

From International seminar on high temperature fracture mechanisms and mechanics; Dourdan, France (13 Oct 1987).

We present some results obtained from a simplified stochastic model of intergranular creep cavitation. The probabilistic features of the model arise from the inclusion of random cavity placement on the grain boundary and time-discrete stochastic cavity nucleation. Among the predictions of the model are Weibull-distributed creep rupture failure times and a Weibull distribution of cavity radii. Both of these predictions have qualitative experimental support. 18 refs., 7 figs.

1173 **(DFVLR-FB—87-15) New fatigue damage analysis of complex engineering components based on FEM.** Ott, W. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.); Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen; Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.). Inst. fuer Werkstoff-Forschung). May 1987. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753298/JAW.

A new type of fatigue damage analysis for multiaxial elastoplastic conditions based on a three-dimensional finite element analysis has been developed. The analysis includes the material model after Mroz. The fatigue life evaluation in the critical areas is based on plastic work at these locations. The proposed damage concept can be applied to arbitrary multiaxial stress-strain paths. For the evaluation of the damage cycles in terms of closed stress-strain hysteresis loops are not required. The damage is determined on the basis of uniaxial material data (stress-strain curve, life to crack iniation curve). With 88 figs., 19 tabs., 62 refs.

1174 **(DOE/ER/01023—7) A study of mechanisms of hydrogen diffusion in separation devices: Final report.** Lee, M.H. (Georgia Univ., Athens (USA). Dept. of Physics). 20 Aug 1987. Contract AS09-77ER01023. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000328/JAW.

Physical properties of hydrogen diffusion in transition metals show considerable potential for technical applications. Towards developing a quantum statistical theory of diffusion, we have constructed and developed a microscopic, dynamic model appropriate for hydrogen in a transition metal. Our work is based on the notion that the basic aggregates of transport are spin clusters of either Fermi or Bose type. Our theory is able to encompass much of the known basic facts including the reversed isotope effect in diffusion. Our model also provides new information on long-time behavior in the velocity autocorrelation function, intrinsic mobility and diffusion which can grow anomalously. To obtain time-dependent properties of our model, we developed a new technique called the method of recurrence relations. This method is a general mathematical technique appropriate for solving time-dependent many-body problems. 34 refs.

1175 **(DOE/ER/45239—2) [Atomic and electronic structure of surfaces and chemisorbed layers]: Progress report, 1 March 1986 to 31 March 1988.** (State Univ. of New York, Stony Brook (USA). Research Foundation). 2 Sep 1987. Contract FG02-86ER45239. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014987/JAW.

Efforts were concentrated on studies of chemisorption on solid surfaces, namely, the formation of mixed layers (as opposed to overlayers) of atoms of metallic adsorbates with atoms of the substrate. These mixed layers are called surface alloys. The studies have involved low-energy electron diffraction (LEED) and ultraviolet photoemission spectroscopy (UPS). Results proved quantitatively the formation of a mixed layer, to determine the relative positions of the atoms in the surface and that the first two atomic layers of the Cu(001)c(2 x 2)-Au phase have essentially the same structure as the first two layers of the (001) surface of the bulk Cu_3Au alloy. We could also show that after formation of the surface alloy there was no measurable ordered content of Au not only in the second, but also in the third atomic layer. UPS showed that the width of the d band of the surface alloy was noticeably narrower than that of the bulk alloy, correcting an earlier misinterpretation; changes were identified in the valence band of the Cu substrate upon formation of the surface alloy; and the Au-induced d bands and their dispersions were determined. The last run at the NSLS (in June 1987) constituted the UPS part of a research project on the formation of another surface alloy. The resulting phase, Cu(001)c(2 x 2)-Pd, was suspected possibly to consist of a mixed layer. 9 refs.

1176 **(DOE/NASA/50112—70) Creep-rupture behavior of a developmental cast-iron-base alloy for use up to 800°C.** Titran, R.H.; Scheuermann, C.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1987. Contract AI01-85CE50112. 16p. (NASA-TM—100167). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000252/JAW.

As part of the DOE/NASA Stirling Engine Systems Project, an iron-base cast alloy was developed, designated NASAUT 4G-Al. Its nominal composition, in percent by weight, is Fe-15Mn-15Cr-2Mo-1.5C-1Nb-1Si. This report presents the results of a study of this alloy, 4G-Al, performed to determine its creep-rupture properties. The alloy was studied in the directionally solidified (DS) form with a 650°C/100 h anneal recommended by UTRC to optimize properties and in the investment-cast (IC) form with either a 760°C/20 h anneal recommended by UTRC to optimize properties, or a solution anneal of 790°C/20 h followed by a simulated brazing cycle of 1065°C/15 min + a heat treatment of 760°C/16 h + 650°C/16 h. Alloy 4G-Al exhibited typical 3-stage creep response under all conditions tested. The most creep resistant condition was the DS material. This condition compares very favorably to the prototype (HS-31) and prime candidate (XF-818) alloys for the automotive Stirling engine cylinder/regenerator housing. 14 refs., 7 figs., 6 tabs.

1177 **(EPRI-EM—4992) Electroslag processing: State-of-the-art assessment: Final report.** Lee, D.C. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Center for Metals Production; Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 42p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920054/JAW.

Electroslag processing is the remelting of an electrode in which the molten material falls in droplets through a molten slag pool. The melting is by direct electric current and the mold can be round or rectangular for ingots (electroslag remelting, ESR) or shaped for finished components (electroslag casting, ESC). Advantages of ESR and ESC are improved cleanliness and homogeneity over air melting and a lower cost than vacuum melting. ESC offers the additional advantage of bypassing investment in forging. Electroslag remelting is widely used in this country for the production of tool steels and some high-quality carbon and alloy steels. Electroslag casting has had only very limited use in the United States, mainly for the production of rolling mill rolls. In this report, the development and use of electroslag processes on a worldwide basis are presented along with their possible impact on Western market economies. Information about the status of US producers is also presented along with how the electroslag process relates to their business. Also discussed is the development of the process in the US; and how it relates to competitive methods.

1178 **(INIS-BR—710) Study of the oxidation behavior of zirconium and its alloys.** Costa, I. (Sao Paulo Univ. (Brazil)). 1985. 125p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703463/JAW.

The oxidation behavior of zirconium, Zircaloy-4 and Zr-2,5% Nb alloy, as well as the influence of temperature, oxidising atmosphere, metal composition, heat treatment, surface treatment and specimen size on the oxidation of these materials in the temperature range 350 - 900/sup 0/C and at atmospheric pressure have been studied with the aid of thermogravimetry. The results indicate that oxidation rate increases with temperature and the rate of oxidation of the zirconium alloys was appreciable beyond 600/sub 0/C. At temperature higher than 500/sup 0/C, the oxidation curves of the zirconium alloys revealed a rate transition, the kinetics after transition being either mixed parabolic and linear or linear. The transition produced an alteration in oxide characteristics, from being dark and adherent and protective, to white or grey and revealing at times cracks and scaling. The oxidation atmospheres were oxygen and air, and the results showed that the extent of oxidation in air was higher than that in oxygen. Among the metals, zirconium showed a low degree of oxidation, and the alloy Zr-2,5% Nb the lowest resistance to oxidation. Specimens heat treated in the α-phase showed the highest resistance to oxidation, and those

heat treated in the β-phase the lowest. Surface treatments in aqueous solutions containing a high concentration of the fluoride ion, left behind fluorates on the surface and increased the oxidation rates of zirconium and zircaloy-4. Specimens with a high proportion of corners in relation to the total area, showed a high extent of oxidation giving rise to cracks in the oxide at the corners.

1179 **(INIS-BR—726) Model for ultrasonic attenuation and elastic constant in chromium and its alloys.** Castro, E.P.; Marques, G.E.; Camargo, P.C. de. (Sao Carlos Univ. (Brazil). Dept. de Fisica). [1987]. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703478/JAW.

A theory based on the thermodynamics of a magnetic system under applied acoustic field is proposed. The calculated attenuation and longitudinal elastic constant for pure chromium and its alloys with diluted vanadium, show a good agreement with the experimental values.

1180 **(INIS-SU—411) Superconductivity effects near metal-insulator transition in granular idnium films. Preprint-no--33-86.** Belevtsev, B.I.; Komnik, Yu.F.; Fomin, A.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1986. 25p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703579/JAW.

The influence of granules superconductivity on the electric properties of granular indium films is investigated under the conditions of partial or full granular localization of electrons. At temperatures below 5 K a minimum of electric resistance and negative magnetoresistance are revealed which are attributed to the competition of hopping conductivity and Josephson intergranular tunneling of electrons. 40 refs.; 7 figs.

1181 **(JAERI-M—87-076) Creep test of Hastelloy X for use as the components of OGL-1 in helium environment.** Ogawa, Yutaka; Kurata, Yuji. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 27p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750289/JAW.

Hastelloy X is used for inner and flow tubes of OGL-1 (Oarai Gas Loop No. 1) installed in JMTR. The tubes were produced by a special procedure, BTA (Boring and Trepanning Association), because of their form of thin wall thickness and large diameter. By this procedure the central part of a forged bar was hollowed out. Creep rupture data for the tube material have been obtained up to 15,000 hr in the longest test period in air. In practice, since the tubes were to be exposed to helium gas, the material was tested in a simulated helium environment. The results obtained were compared with the air data and also the other set of creep data accumulated with Hastelloy XR. The latter data contain those on tube and bar materials and have been provided for design of HTGR. The results obtained by the test at 900 deg C in helium to the maximum test duration up to 10,000 hr yielded the following conclusions; (1) Hastelloy X for OGL-1 (OGL-HX hereafter) showed longer rupture life accompanied by smaller cracks in helium than that tested in air. (2) Rupture life was shorter in the following order; the tube material of Hastelloy HR (HR hereafter), the bar material of XR and OGL-HX. (3) Rupture elongation was the highest in the bar material of XR and minimum in tube material of XR. The value OGL-HX was middle of the two. (4) Creep rate was lowest for OGL-HX, however in the lower stresses range the value of the tube material of XR approached to that of OGL-HX. The results were discussed from the view point of minor impurities, production processes and microstructure eg. annealing twin.

1182 **(JAERI-M—87-087) Laser-treatment condition of plasma-sprayed zirconia thermal barrier coatings on nickel-base superalloy substrate.** Kondo, Yasuo; Fukaya, Kiyoshi; Miyamoto, Yoshiaki. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 40p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750295/JAW.

In order to seal the surface pores, two plasma-sprayed zirconia coatings (containing 8 wt.% CaC/sub 2/ and 8 wt.% Y/sub 2/O/sub 3/) of about 200 microns thickness were partially melted with a CO/sub 2/ laser. Preliminary experiment had shown that the laser beam with a power density of 35 W/mm/sup 2/ could melt plasma-sprayed zirconia to depth of 50 to 80 microns at a scanning speed of about 300 mm/min. There was little porosity in the laser-treated region. However, straiations and mud-flat cracking of about 50 microns in depth were produced by the laser-treatment. Numerous fine particles of a few microns diameter were formed on the laser-treated surface, and microcracks were propagated between these fine particles. In the CaC/sub 2//ZrO/sub 2/ ceramic coating system, calcium content of the laser-treated region became less compared with that of the nontreated region. While, in the Y/sub 2/O/sub 3//ZrO/sub 2/ system, yttrium distribution in the laser-treated area was more uniform than that in the nontreated area. This indicates that Y/sub 2/O/sub 3//ZrO/sub 2/ system is more stable than CaC/sub 2//ZrO/sub 2/ system to laser treatment.

1183 **(JAERI-M—87-095) Application of AC-impedance method on determination of corrosion rate of metals.** Suzuki, Motoe. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 38p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750307/JAW.

The AC-impedance technique was experimentally evaluated as one of the in-situ measuring means to determine the corrosion rate of metals immersed in aqueous solutions. Surface impedance of corroding metals was measured by both the FET and FRA methods using the system consisting of a personal computer and digital wave memories, and the two methods were compared with respect to accuracy and error factors. The tested systems were stainless steel-sulfric acid, stainless steel-chloric acid, titanium-nitric acid and zirconium-nitric acid. The measurement permitted to estimate a very low corrosion current density of firmly passivated specimens. For the stainless steel corroding actively in chloric acid, weight change of the specimen calculated from its impedance data was coincided within 2.5 % difference with the value determined by direct weighing. This indicates the capability of the impedance technique to determine corrosion rate of sample on the basis of the previously obtained correlation between measured weight change and impedance data of the same metal-solution system as the sample. In other words, on-line sensing of corrosion rate is possible.

1184 **(Juel—1982) Influence of chemisorbed hydrogen molecules on the H-permeation and recycling. Pt. 1. Model and equations.** Waelbroeck, F. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik). Mar 1985. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753283/JAW.

We have shown in a previous report that a 'molecular chemisorption model' (MCM) is better adapted than the dissociative chemisorption model (DCM) of Lennard-Jones to describe the solubility and permeation behaviours of hydrogen in metals and alloys such as iron, nickel, copper, steels and Inconels. It was further shown that the MCM allows to account adequately for the measurements made in surface physics on hydrogen adsorption on these metals. A corollary of the MCM is that the (H/sub 2/)/sub a/ admolecules should catalyse the recombinative release of hydrogen out of these lattice. This effect should strongly influence the permeation experiments made under simultaneous atomic and molecular exposures. Incident electrons should moreover dissociate the chemisorbed molecules when the electron energy is sufficiently high. This increases the fluxes of hydrogen penetrating into and permeating through the lattice; it also decreases the surface coverage factor and the catalytic activity of the admolecules (H/sub 2/)/sub a/ upstream. This report analyses these effects. It is shown that permeation measurements can provide valuable information on the kinetics and equilibrium properties of the adsorbed layer and that the behaviour predicted by the MCM is in several aspects surprising a priori. The latter is however observed, as shown by measurements which will be presented and discussed in another report.

1185 **(Juel-Spez—379) Plasticity - a limiting case of creep.** Cords, H.; Kleist, G.; Zimmermann, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). Nov 1986. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753321/JAW.

The present work is an attempt to develop further the so-called unified theory for viscoplastic constitutive equations as used for metals or metal alloys. Typically, in similar approaches creep strains and plastic strains are derived from one common stress-strain relationship for inelastic strain rates employing an internal stress function as a back stress. Some novel concepts concerning the definition of the internal stress, plastic yielding and material hardening have been introduced, formulated mathematically and tested for correspondence with a standard type of materials behaviour. As a result of the investigations a system of simultaneous differential equations is defined which has been used to elaborate a common view on a number of different material effects observed in creep and plasticity i.e. normal and inverted primary creep, recoverable creep, incubation time and anelasticity in stress reduction, negative stress relaxation, plastic yielding, perfect plasticity, negative strain rate sensitivity, serrated flow, strain hardening in monotonic and cyclic loading. The theoretical approach is mainly based on a lateral contraction movement not following rigidly the longitudinal extension of the material specimen by a prescribed constant value of Poisson's ratio as usual, but following the axial extension in a process of drag which allows for retardation and which simultaneously impedes the longitudinal straining.

1186 **(K/ETAC—31) Damping characteristics of a composite-reinforced stainless-steel plate.** Andriulli, J.B.; Grimsby, H.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Sep 1987. Contract AC05-84OT21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000303/JAW.

The investigation of damping characteristics of composite-steel laminates was initiated for the Naval Underwater Systems in March 1987. Phase 2 of the Composite Damping Task consists of fabricating a composite laminated stainless-steel plate and comparing the damping characteristics to that of a "bare" stainless-steel plate. This report summarizes the activities initiated under Phase II of this project performed at the Enrichment Technology Applications Center, Martin Marietta Energy Systems, Inc.

1187 **(KFK—4217) Creep-rupture tests on the SNR 300 cladding-material X10NiCrMoTiB 1515 (DIN 1.4970) in the reference heat treatment (solution-annealed + cold-working + annealed).** Schirra, M.; Ritter, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jun 1987. 39p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753318/JAW.

The SNR 300-cladding material X10NiCrMoTiB 1515 (DIN 1.4970) was creep tested in the temperature range of 600-700degC over rupture time up to 42 000 hours. In addition to the availability of the experimental values for the reliability of the design, the remarkable result is the change of the stress-dependency of the minimum creep rate in the range at lower stresses with the tendency to higher creep-rate. A result which we cannot extrapolate from short-time-tests. The creep-rupture ductility in the time range of 10/sup 2/ - 2x10/sup 4/ hours enclose values from 10-15% at test temperatures of 600-700degC. They can correlate the mechanical test results with the time-temperature-precipitation behaviour.

1188 **(KFK—4261) Comparative tests of high temperature creep-rupture behavior of the austenitic CrNi steel DIN W.Nr. 1.4970 in argon and steam.** Schanz, G.; Leistikow, S.; Berg, H. von. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). May 1987. 48p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753312/JAW.

With respect to its suitability as alternative cladding material in an Advanced Pressurised Water Reactor (APWR), the austenitic chromium nickel steel DIN No. 1.4970 was subjected to a laboratory investigation of its creep-rupture behavior: In parallel in argon and in steam at 950-1200degC, ca. 10-100 bar, ca. 1 min - 1 h. In comparison to burst tests under inert atmosphere the oxidising material shows slightly reduced strength combined with considerably reduced circumferential burst elongation. Above a strain maximum at about 1100degC the elongations decrease with increasing temperature and duration. The extent and the influence of the oxidation on the mechanical properties is discussed on the basis of the microstructure of the oxide scale.

1189 **(LA-UR—87-2805) Experimental perspectives on heavy electron metals.** Fisk, Z.; Ott, H.R.; Aeppli, G. (Los Alamos National Lab., NM (USA); Eidgenoessische Technische Hochschule, Zurich (Switzerland); Bell Labs., Murray Hill, NJ (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870873—15). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014766/JAW.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

We motivate the description of heavy electron metals in terms of concepts from the Kondo problem. These concepts are used to discuss magnetism and superconductivity in heavy electron systems. Particular attention is given to what we view as the principal outstanding questions in this field and direction in which the field is developing. This will include consideration of the differences between Ce and U heavy electron compounds, as well as the occurrence of very small ordered magnetic moments. 26 refs., 5 figs.

1190 **(LBL—23757) Cu_3Pd observed by high-voltage electron microscopy.** Kulik, J.; Takeda, S.; de Fontaine, D. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 14p. (CONF-8705168—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000204/JAW.

From Workshop on competing interactions and microstructures: statics and dynamics; Los Alamos, NM, USA (5 May 1987).

Cu-Pd samples of compositions varying from 16 to 26 at.% Pd were irradiated in situ in a 1.5-MeV electron microscope at various temperatures. Low-temperature (90°K) irradiation produced completely disordered solid solutions. Irradiation at room temperature up to as high as about 500°K produced steady state short range order (SRO) which, for specimens of 18% or more Pd, is characterized by diffuse intensity at [1 +-q,0] and equivalent positions in reciprocal space (modulated SRO). In general, q is a function of composition, temperature and irradiation dose. High temperature irradiation tended to produce the expected equilibrium long range order - either $L1_2$ or a long period superstructure depending on composition and temperature. The 18 to 20% samples irradiated at room temperature exhibited steady state modulated SRO even though the expected equilibrium structure is one of unmodulated order ($L1_2$). It is suggested that spinodal ordering is responsible for this latter effect. An f.c.c. based Cu-Pd phase diagram is proposed incorporating ordering stability loci and a metastable Lifshitz point. 37 refs., 12 figs.

1191 **(LBL—23811) The accommodation of precipitate plates modelled as a tensile test.** Dahmen, U.; Westmacott, K.H. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 13p. (CONF-870719—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000207/JAW.

From 2. international conference on phase transformations in solids; Cambridge, UK (6 Jul 1987).

Thin-plate precipitates in transformations with principal stains of mixed sign are approximately in a state of uniaxial stress if the interface contains an invariant line. This similarity to a tensile test can be used for the prediction of coherent and semicoherent plate habits; to relieve the uniaxial stress the tensile axis must lie in an elastically soft direction for coherent plates and at approximately 45° to the operative slip system for semicoherent plates. The habit plane is the plane that contains both the invariant line and tensile axis. Predictions of this simple model are shown to be in excellent agreement with available experimental observations on plate precipitates in several bcc interstitial alloys. 27 refs., 3 figs., 1 tab.

1192 (LBL—23937) The structure of adsorbed sulfur and carbon on molybdenum and rhenium single crystal surfaces, and their influence on carbon monoxide and hydrocarbon chemisorption. Kelly, D.G. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 285p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88001393/JAW.

An ultra-high vacuum (10^{-10} Torr) study was performed on the chemisorption and structures of S and C adsorbates on Mo(100), Re(0001), and Re(1010) single crystal surfaces. Both S and C adsorb strongly on Mo(100), Re(0001), and Re(1010), with adsorption energies >70 kcal/mol for coverages less than saturation. S was proposed to adsorb in the highest symmetry sites on all surfaces except for θ/sub s/ > 0.75 on Mo(100), where studies suggest two different adsorption sites. C adsorbs in a "carbidic" or active phase on Mo(100), where it is also proposed to adsorb in the highest symmetry sites. However, C adsorbs in a "graphitic" or inactive phase on Re(0001) and Re(1010). CO chemisorption on the S and C overlayers was found to be blocked (except for C on Mo(100)), with S blocking adsorption more efficiently than C. Changes in adsorption energy were determined to be caused by local crowding of CO molecules by S or C, rather than a long-range electronic interaction. Unsaturated hydrocarbons decomposed completely on Mo(100), Re(0001), and Re(1010). Similar to the results for CO chemisorption, strong adsorption of unsaturated hydrocarbons (leading to decomposition) was blocked by pre-adsorbed S, allowing only physisorption to occur (adsorption energies < 11 kcal/mol). The effect of pre-adsorbed "graphitic" C on Re(0001) and Re(1010) on unsaturated hydrocarbon chemisorption was the same; strong adsorption (leading to decomposition) was blocked allowing only physisorption. However, Mo(100) with pre-adsorbed "carbidic" carbon blocks only decomposition while allowing strong reversible molecular chemisorption (12 to 23 kcal/mol). Differences in inhibition efficiency of S and C are proposed to be caused by differences in bond distances of the adsorbates to the surface. Greater distance from the metal surface causes more interaction with neighboring metal atoms. These differences also suggest explanations for catalytic hydrodesulfurization of thiophene.

1193 (N—87-25456) Study of reduced chromium content in a nickel-base superalloy via element substitution and rapid solidification processing. Ph.D. Thesis. Final report. Powers, W.O. (Illinois Univ., Urbana (USA)). May 1987. 288p. (NASA-CR—179631; NAS—1.26:179631). NTIS, PC A13/MF A01.

A study of reduced chromium content in a nickel base superalloy via element substitution and rapid solidification processing was performed. The two elements used as partial substitutes for chromium were Si and Zr. The microstructure of conventionally solidified materials was characterized using microscopy techniques. These alloys were rapidly solidified using the chill block melt spinning technique and the rapidly solidified microstructures were characterized using electron microscopy. The spinning technique and the rapidly solidified microstructures was assessed following heat treatments at 1033 and 1272 K. Rapidly solidified material of three alloys was reduced to particulate form and consolidated using hot isostatic pressing (HIP). The consolidated materials were also characterized using microscopy techniques. In order to evaluate the relative strengths of the consolidated alloys, compression tests were performed at room temperature and 1033 K on samples of as-HIPed and HIPed plus solution treated material. Yield strength, porosity, and oxidation resistance characteristics are given and compared.

1194 (N—87-25459) Observations of directional gamma prime coarsening during engine operation. Draper, S.L.; Hull, D.R.; Dreshfield, R.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Feb 1987. 11p. (NASA-TM—100105; E—3642; NAS—1.15:100105; CONF-870272—10). NTIS, PC A02/MF A01.

From American Institute of Metallurgical Engineers annual meeting: light metals session; Denver, CO, USA (22 Feb 1987).

Two alloys with negative mismatch parameters, NASAIR 100 and a modified NASAIR 100 called Alloy 3 were run as turbine blades in an experimental ground based Garret TFE731 engine for up to 200 hr. The directional coarsening of gamma prime (rafting) that developed during engine testing was analyzed and compared to previous research from laboratory tests. The blades were found to be rafted normal to the centrifugal stress axis over much of the span, but near the surfaces, the blades were found to be rafted parallel to the centrifugal stress axis for certain cycles. Representative photomicrographs of the blades and the effects of stress and temperature on raft formation are shown.

1195 (N—87-25463) Hydrogen trapping and the interaction of hydrogen with metals. Danford, M.D. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Jul 1987. 36p. (NASA-TP—2744; NAS—1.60:2744). NTIS, PC A03/MF A01.

A method has been developed for the determination of trapped hydrogen in metal alloys, involving the determination of mobile hydrogen using the electrochemical method and the determination of total hydrogen with the fusion method, the difference in hydrogen concentrations being due to trapped hydrogen. It has been found that hydrogen enters body-centered cubic structures through the grain bodies rather than through the grain boundaries. Hydrogen also diffuses much more rapidly in body-centered cubic structures on charging than in face-centered cubic structures, the hydrogen distribution being more uniform in nature. The energy necessary to cause hydrogen embrittlement is postulated to arise from the changes in crystal lattice energies brought about through interaction of hydrogen with atoms in the metal lattice. The total energy change is more negative for body-centered cubic structures, believed to be the cause of a greater tendency toward hydrogen embrittlement. Finally, the agreement of hydrogen concentrations obtained at 25 C by the electrochemical method with those obtained by the fusion method are taken as a strong indication of the power and validity of the electrochemical method.

1196 (N—87-25823) Enhanced thermal emittance of space radiators by ion-discharge chamber texturing. Mirtich, M.J.; Kussmaul, M.T. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 14p. (NASA-TM—100137; E—3687; NAS—1.15:100137; CONF-870388—14). NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

The discharge chamber of a 30-cm argon ion source was successfully used to texture potential space radiator materials for the purpose of obtaining values of thermal emittance greater than 0.85 at 700 and 900 K. Some samples were also treated in acid prior to texturing. To evaluate the durability of the textured materials to atomic oxygen, samples were exposed to an RF air plasma environment. The spectral emittance between 2.0 anf 15.0 microns was measured before and after the textured materials were exposed to the plasma asher. The results indicate that copper with extremely high values of emittance after texturing (0.978 and 0.983) at 700 and 900 K, respectively,did not change its values of emittance after ashing, whereas the emittance of stainless steel fell below 0.85 after ashing. These data, along with scanning electron photomicrographs, and the results of texturing and ashing titanium and Nb(1)Zr are presented.

1197 (N—87-25984) Cosmic ray heavy ion LET mapping for aluminum, silicon, and tissue targets. Stassinopoulos, E.G.; Barth, J.M.; Jordan, T.M. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Apr 1987. 264p. (NASA-RP—1180; REPT—87B0034; NAS—1.61:1180). NTIS, PC A12/MF A01.

Linear energy transfer (LET) values in aluminum, silicon, and tissue targets have been calculated for 31 galactic cosmic ray ion species in eight different units. The values are described for single event upset (SEU) effect assessments or radiobiological evaluations. The data are presented in graphical and tabular form.

1198 (N—87-26173) **Proceedings of the NASA workshop on atomic oxygen effects.** Brinza, D.E. (Jet Propulsion Lab., Pasadena, CA (USA)). Jun 1987. 195p. (NASA-CR—181163; JPL—87-14; NAS—1.26:181163; CONF-8611131—). NTIS, PC A09/MF A01.

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

A workshop was held to address the scientific issues concerning the effects of atomic oxygen on materials in the low Earth orbital (LEO) environment. The program included 18 invited speakers plus contributed posters covering topics such as LEO spaceflight experiments, interaction mechanisms, and atomic oxygen source development. Discussion sessions were also held to organize a test program to evaluate atomic oxygen exposure facilities. The key issues raised in the workshop were: (1) the need to develop a reliable predictive model of the effects of long-term exposure of materials to the LEO environment; (2) the ability of ground-based exposure facilities to provide useful data for development of durable materials; and (3) accurate determination of the composition of the LEO environment. These proceedings include the invited papers, the abstracts for the contributed posters, and an account of the test program discussion sessions.

1199 (N—87-26173, pp vp) **Role of electronic mechanisms in surface erosion and glow phenomena.** Haglund, R.F. Jr. Jun 1987. NTIS, PC A09/MF A01. (NASA-CR—181163; JPL—87-14; NAS—1.26:181163; CONF-8611131—).

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

Experimental studies of desorption induced by electronic transitions (DIET) are described. Such studies are producing an increasingly complete picture of the dynamical pathways through which incident electronic energy is absorbed and rechanneled to produce macroscopic erosion and glow. These mechanistic studies can determine rate constants for erosion and glow processes in model materials and provide valuable guidance in materials selection and development. Extensive experiments with electron, photon, and heavy particle irradiation of alkali halides and other simple model materials have produced evidence showing that: (1) surface erosion, consisting primarily in the ejection or desorption of ground-state neutral atoms, occurs with large efficiencies for all irradiated species; (2) surface glow, resulting from the radiative decay of desorbed atoms, likewise occurs for all irradiating species; (3) the typical mechanism for ground-state neutral desorption is exciton formation, followed by relaxation to a permanent, mobile electronic defect which is the precursor to bond-breaking in the surface or near-surface bulk of the material; and (4) the mechanisms for excited atom formation may include curve crossing in atomic collisions, interactions with surface defect or impurity states, or defect diffusion.

1200 (N—87-26209) **Investigation of temperature and concentration oscillations in the directional solidification of Pb-Sn-Te. Semiannual progress report, 1 August 1986-31 January 1987.** Anderson, T.J.; Narayanan, R. (Florida Univ., Gainesville (USA)). Jan 1987. 24p. (NASA-CR—180565; NAS—1.26:180565). NTIS, PC A02/MF A01.

Directional solidification of the pseudobinary compound semiconductor material Pb sub 1-x Sn sub x Te by the Bridgman crystal growth process will be studied. Natural convection in the molten sample will be visualized with a novel electrochemical cell technique that employs the solid electrolyte material yttria-stabilized zirconia. Mass transfer by both diffusion and convection will be measured by detecting the motion of oxygen tracer in the liquid. Additional applications for electrochemical cells in semiconductor crystal growth are suggested. Unsteady convection in the melt will also be detected by the appearance of temperature oscillations. The purpose of this study is to experimentally characterize the overstable conditions for a Pb sub 1-x Sn sub x Te melt in the vertical Bridgman crystal growth technique and use a linear analysis to predict the onset of convection for this system.

1201 (N—87-26359) **Nondestructive ultrasonic characterization of two-phase materials. Final report.** Salama, K. (Houston Univ., TX (USA)). Jan 1987. 29p. (NASA-CR—180694; NAS—1.26:180694). NTIS, PC A03/MF A01.

The development of ultrasonic methods for the nondestructive characterization of mechanical properties of two phase engineering materials are described. The primary goal was to establish relationships between the nonlinearity parameter and the percentage of solid solution phase in two phase systems such as heat treatable aluminum alloys. The acoustoelastic constant was also measured on these alloys. A major advantage of the nonlinearity parameter over that of the acoustoelastic constant is that it may be determined without the application of stress on the material, which makes the method more applicable to inservice nondestructive characterization. The results obtained on the heat treatable 7075 and the work hardenable 5086 and 5456 aluminum alloys show that both the acoustoelastic constant and the acoustic nonlinearity parameter change considerable with the volume fraction of second phase precipitates in these aluminum alloys. A mathematical model was also developed to relate the effective acoustic nonlinearity parameter to volume fraction of second phase precipitates in an alloy. The equation is approximated to within experimental error by a linear expression for volume fractions up to approx. 10%.

1202 (NAGRA-NTB—82-08) **Corrosion behaviour of unalloyed steel, cast steel and cast iron as final storage canister material in water-bearing granite rocks.** Heitz, E.; Megede, D. zur. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1982. 40p. (In German). Nagra, CH-5401 Baden, Switzerland.

During final storage of radioactive waste the corrosion behaviour of the canister materials is an important parameter. In this study the external corrosion behaviour of unalloyed steel, cast steel and cast iron in water-bearing granite rocks is discussed with a particular view to the conditions in Switzerland (temperature, pressure, water composition, etc.). The report is based on a critical literature review, on the author's own experience and on experience from other fields of technology. Furthermore, model calculations are made for corrosion rates to be expected in the presence of a mass transfer barrier. The most important results are as follows: -corrosion rates in waters and soils are low, provided oxygen is excluded or protective layers are formed, -under the expected conditions all of the relevant waters can produce significant corrosion, -the pressure dependence of the corrosion rate is small, while the temperature dependence is large, -in the presence of an effective convection and diffusion barrier (bentonite) the corrosion rate is very small (10/sup -5/ mm/year), -if such a barrier maintains its properties for the required lifetime of the final storage system the corrosion rate of the canister material can be neglected.

1203 (NAGRA-NTB—83-17) **Corrosion behaviour of metallic and non-metallic materials in various media in the Anhydrite and Gypsum Mine Felsenau/AG.** Laske, D.; Wiedemann, K.H. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1983. 36p. (In German). Nagra, CH-5401 Baden, Switzerland.

The final underground disposal of radioactive wastes necessitates container materials with a good long-term resistance against corrosion from both external agents and the solidification matrix inside. For low- and medium-level active waste, repositories in anhydrite sites, among others, are under consideration. Sheet and plate samples from 14 metallic and 8 non-metallic materials have been tested for 5 years in a tunnel in the Anhydrite and Gypsum Mine Felsenau/AG for their corrosion resistance in the tunnel atmosphere, anhydrite powder, gypsum powder, gypsum, and cement. From the metallic materials tested, only chromium-nickel steel is corrosion resistant to all the media present. Zinc plated and tin plated iron sheet as well as aluminium and aluminium alloys are corrosion resistant only in the atmosphere of the tunnel, and lead plated iron sheet is resistant also in cement. Aluminium is dissolved in cement. Uncovered iron sheet undergoes severe corrosion. The non-metallic coatings tested (lacquer, stove lacquer, or synthetic resins) partially flake off already after one year's testing and are therefore not appropriate for iron sheet corrosion protection. No influence of the different media has been observed after 5 years on the 8 plastic materials tested (6 without, and 2 with glass fiber reinforcement).

1204 **(ORNL—6412) Development of nickel-iron aluminides.** Liu, C.T.; Cathcart, J.V.; Goodwin, G.M.; Horton, J.A.; Lee, E.H.; Campbell, J. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001491/JAW.

The objective of this program is to design and characterize new, improved high-temperature materials based on boron-doped Ni_3Al + Fe for structural use in advanced coal conversion systems. Chromium is a key alloying element that improves resistance to oxidation, corrosion, and environmental embrittlement in nickel-iron aluminides by promoting the rapid formation of protective oxide scales. Alloying with 3 to 7 at.% Cr dramatically reduces dynamic embrittlement in oxidizing environments at 400 to 800°C. Chromium and iron additions increase the stability of the ordered body-centered cubic phase that is brittle at room temperature and weak at elevated temperatures. The formation of the B2 phase in the aluminides leads to lowering the tensile ductility at lower temperatures and the strength at higher temperatures. This study of alloying effects has led to the development of an aluminide with the composition: Ni-18.5 +- 0.5% Al-10.5 +- 0.5% Fe-7 +- 0.5% Cr-0.2% Zr-0.7% Mo-0.1% B(at.%). Corrosion studies have demonstrated that chromium additions of 7 at.% or greater were very effective in minimizing the sulfur attack on nickel-iron aluminides. Sulfidation protection can also be afforded by oxide films produced in air; however, the oxidation temperature should be 1000 to 1050°C, and the alloys must contain 3 at.% or greater chromium. The nickel-iron aluminides developed were weldable using both the electron beam and gas tungsten arc processes. 19 refs., 24 figs., 9 tabs.

1205 **(RFP—4050) Tritium permeation through characterized films on Type 304L stainless steel.** Kallas, A.J.; Rising, T.L.; Childs, E.L.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 24 Jul 1987. Contract AC04-76DP03533. 19p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000712/JAW.

Rocky Flats is looking for an optimum method for surface treating 304L stainless steel to increase its resistance to tritium permeation. Selected surface treatments were applied to 304L samples. One set of samples was shipped to the Rockwell Corporate Science Center for alternate characterization analysis. Another set was sent to Los Alamos National Laboratory for tritium exposure and ion beam spectrographic analysis. The Science Center performed the following analyses: ellipsometry, contact potential, photoelectron emission, surface energy, surface activation, cathodic polarization, electrochemical impedance, and open-circuit potential. Excellent correlation was found between type of treatment and surface activation and electrochemical impedance. Results of the Science Center tests correlated well with actual tritium permeation measurements made at Los Alamos. 8 refs., 8 figs., 1 tab.

1206 **(SAND—87-0966C) The evolution of plastic strain in steady, plastic shock waves.** Dunn, J.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—77). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013812/JAW.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

This study is a brief summary of some recent efforts to understand the constitutive implications of empirical relations like the following: P/sub D/ = k times the absolute value of (d ϵ/sub m/dt)/sup 1/4/, where P/sub D/ is the impact needed to create a plastic shock wave, k is a material constant, and d ϵ/sub M//dt / sup 1/4/ is the peak strain rate in that wave. This is in the context of viscoplasticity theories that introduce an internal state variable for the plastic strain and a companion rate law for its evolution. 5 refs., 1 fig.

1207 **(SAND—87-2464C) US neutron effects work under SUBWOG-6N.** Schmidt, T.R.; Bryson, J.W.; Luera, T.F. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 21p. (CONF-8710158—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000427/JAW.

From Effects technology forum conference; Aldermaston, UK (12 Oct 1987).

the scope of S-6N is to study the effects of neutrons on weapons materials and structures, particularly fissionable ones, but excluding electronic components. Included in the scope are: development of laboratory neutron sources and technology; development of reactor and experiment diagnostics; the study of materials and structural responses under dynamic neutron heating; and the study of the combined effects of neutron and related environments, such as blast loadings concomitant with an endoatmospheric encounter. A principal activity associated with S-6N on the part of the US has been the simulation experiments performed at SNL using the reactor facilities. These tests have also been supported with analytical efforts in order to understand the test results and apply them to warhead development and STS requirements. Included in this paper is: (1) a description of the scope and activities of S-6N, (2) the neutron effects tests conducted to date, (3) the current Sandia National Laboratories (SNL) reactor and support facilities used for neutron effects testing, (4) future proposed facilities, and (5) modifications to existing facilities, an assessment of the future activities, and the future of S-6N.

1208 **Structure of bimetallic clusters. Extended x-ray absorption fine structure (EXAFS) of Pt—Re and Pd—Re clusters.** Meitzner, G.; Via, G.H.; Lytle, F.W.; Sinfelt, J.H. (Corporate Research Science Laboratories, Exxon Research and Engineering Company, Annandale, New Jersey 08801). *Journal of Chemical Physics;* **87**: No. 11, 6354-6363(1 Dec 1987).

Extended x-ray absorption fine structure (EXAFS) studies were conducted on catalysts containing platinum and rhenium, or palladium and rhenium, on alumina. The atomic ratio of rhenium to either platinum or palladium was close to one in the catalysts investigated. The metallic entities in the catalysts were characterized by analyses of the EXAFS associated with the L/sub I/ absorption edge of platinum, the L/sub III/ edge of rhenium, and the K absorption edge of palladium. It was concluded that Pt—Re and Pd—Re bimetallic clusters are present in the catalysts. However, the clusters have regions rich in rhenium and other regions which are rich in either platinum or palladium. Exposure of Pt—Re clusters to sulfur has little influence on their structure.

1209 **Maximum thickness of amorphous NiZr interlayers formed by a solid-state reaction technique.** Meng, W.J.; Nieh, C.W.; Johnson, W.L. (California Institute of Technology, Pasadena, California 91125). *Applied Physics Letters;* **51**: No. 21, 1693-1695(23 Nov 1987).

Formation of the equilibrium intermetallic compound NiZr in sputter deposited Ni/Zr diffusion couples is suppressed by the formation of a metastable amorphous NiZr alloy until a critical thickness of the amorphous NiZr interlayer is reached. The temperature dependence of this critical thickness is studied experimentally. A phenomenological model based on the premise of interfacial heterogeneous nucleation is proposed to understand the evolution of Ni/Zr diffusion couples.

1210 **Physics of ferromagnetic amorphous alloys.** O'Handley, R.C. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Applied Physics;* **62**: No. 10, R15-R49(15 Nov 1987).

After some introductory comments on materials classification and a brief historical outline, this review seeks to identify those fundamental physical phenomena that underlie the major technical properties of ferromagnetic amorphous alloys. Those phenomena are reviewed and an attempt is made to compare existing data and, where possible, to synthesize new perspectives. A fundamental approach is taken in the sense that we move from consideration of the local atomic structure to its consequences for the electronic structure and from the electronic structure finally to the physical properties it determines. We focus on the aspects of the structure-property sequence that set amorphous metallic alloys apart from their crystalline counterparts. Such a review would be incomplete without addressing the new issues and insights raised by the discovery of the quasicrystalline state. The very existence and better understood atomic arrangements of quasicrystals help to define and illuminate their amorphous cousins.

1211 **Fabrication of oxide superconductors from multilayered metallic thin films.** Nastasi, M.; Arendt, P.N.; Tesmer, J.R.; Maggiore, C.J.; Cordi, R.C.; Bish, D.L.; Thompson, J.D.; Cheong, S.; Bordes, N.; Smith, J.F.; and others. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Materials Research;* 2: No. 6, 726-731(Nov 1987).

Thin-film $GdBa_2Cu_3O$/sub x/ superconductors with an onset T/sub c/ >90 K have been produced. The films were fabricated by thermal reaction in an oxidizing atmosphere of electron-beam deposited Ba/Gd/Cu multilayers. Attempts to produce the superconducting phase YBa_2Cu_3O/sub x/ by multilayer reaction were unsuccessful due to a positive heat of mixing between Y and Ba. The appearance of a wide superconducting transition in $GdBa_2Cu_3O$/sub x/ films may be the result of tunneling through a nonsuperconducting second phase.

1212 **Role of thermal spikes in energetic displacement cascades.** de la Rubia, T.D.; Averback, R.S.; Benedek, R.; King, W.E. (Department of Physics, SUNY at Albany, Albany, New York 12222). *Physical Review Letters;* 59: No. 17, 1930-1933(26 Oct 1987).

The role of thermal spikes in energetic displacement cascades has been investigated by molecular-dynamics computer simulation. For cascade energies of 3 and 5 keV in Cu, which are the highest energies (in reduced units) yet treated by fully dynamical simulations, it is found that local melting occurs and persists for several picoseconds. The implications of this behavior for atomic mixing, Frenkel-pair production, and point-defect clustering are discussed.

1213 **Stability of the missing-row reconstruction on fcc (110) transition-metal surfaces.** Ho, K.h.; Bohnen, K.P. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review Letters;* 59: No. 16, 1833-1836(19 Oct 1987). Contract W-7405-ENG-82.

Analysis of the results from first-principles calculations produces physical insights to the stability of the missing-row reconstruction on the Au(110) surface. The absence of the missing-row reconstruction on the (110) faces of other fcc metals and the possibility to induce the reconstruction by charge transfer are also explained.

1214 **Strain-induced surface segregation and ordering in pseudomorphic metal-alloy overlayers.** Dodson, B.W. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185-5800). *Physical Review [Section] B: Condensed Matter;* 36: No. 12, 6288-6291(15 Oct 1987).

The stability of pseudomorphic metal films on a substrate composed of a different and lattice-mismatched metal against strain relief through intermixing is studied via atomistic simulations. Interdiffusion and lattice relaxation of the initial pseudomorphic structure is treated using a Monte Carlo procedure in which the structural energy of the bimetallic system is obtained using the embedded-atom method. Pseudomorphic overlayers of Ag were placed on [100] substrates of Pt (4.3% mismatch) and of Au (0.25% mismatch). Upon annealing at 1000 K, the Ag alloys with both substrates through interdiffusion. The Ag forms a uniform solid solution with the Au substrate. However, the Ag is trapped near the Pt surface by formation of slightly disordered Pt_3Ag layers. This trapping of Ag near the Pt surface in the ordered Pt_3Ag phase is induced by the misfit strain of the interdiffusing overlayer.

1215 **(N—87-25461) Invar Elinvar type amorphous Se-Cr-B alloys with high corrosion resistance.** Kikuci, M.; Fukamichi, K.; Masumoto, T. Translated from *Nippon Kinzoku Gakkaishi ;* 43: No. 10, 885-890(Jul 1987). 20p. (NASA-TT—20052; NAS—1.77:20052). NTIS, PC A02/MF A01.

Amorphous (Fe(1-x)Cr(x))85B15 alloys (x = 0 to 0.15) were prepared from the melts by rapid quenching using a single roller techinque, and their Invar and Elinvar characteristics and corrosion resistance were investigated. With an increase in chromium content the Curie temperature and the saturation magnetic moment per iron atom decreased monotonically, while the crystallization temperature increased gradually. The thermal expansion coefficient alpha around room temperature became slightly larger with increasing chromium content. Nevertheless, these amorphous alloys exhibited excellent Invar characteristics below the Curie temperature. The value of Young's modulus increased remarkably in a relatively low magnetic field and then saturated at a field of about 80 kA/m, showing a large delta E effect. Its value as well as a longitudinal linear magnetostriction became smaller with an increase in chromium content. The temperature coefficient of Young's modulus changed from postive to negative, and the temperature range showing the Elinvar characteristics became narrower with chromium content. The temperature coefficient of delay time determined from the values of alpha and e was very small. The corrosion resistance of these alloys was extremely improved by chromium addition.

1216 **Thermal conductivity of Inconel 718 and 304 stainless steel.** Sweet, J.N.; Roth, E.P.; Moss, M. (Sandia National Labs., Albuquerque, NM). *International Journal of Thermophysics;* 8: No. 5, 593-606(Jul 1987). Contract AC04-76DP00789.

The results of thermal conductivity measurements on Inconel 718 and 304 stainless steel by the comparative and flash diffusivity techniques are reported for the temperature range 0-700°C. For 304 stainless steel, excellent agreement with published data is found for the specific heat, thermal diffusivity, and thermal conductivity. In the case of Inconel 718, the measurements show that the conductivity depends critically on the sample thermal history and the metallurgical condition of the alloy. Measurements on a solution-treated sample indicated a conductivity function close to that reported previously, while precipitated samples showed a higher conductivity, similar to the conductivity-vs-temperature function used for reduction of comparative thermal conductivity data with Inconel 718 references. These results indicate that Inconel 718 is not a suitable reference for high-accuracy comparative thermal conductivity measurements unless its thermal history and associated conductivity function are known.

1217 **Thermodynamic properties of aluminum.** Desai, P.D. (Purdue Univ., West Lafayette, IN). *International Journal of Thermophysics;* 8: No. 5, 621-638(Jul 1987).

This work reviews and discusses the data on the thermodynamic properties of aluminum available through May 1984. However, two papers dated 1985 which are useful to this work are also included. These properties include heat capacity, enthalpy, enthalpy of transition and melting, vapor pressure, and enthalpy of vaporization. The recommended values for heat capacity cover the temperature range from 0.1 to 2800 K. The recommended values for enthalpy, entropy, Gibbs energy function, and vapor pressure cover the temperature range from 298.15 to 2800 K.

1218 **Frequency-dependent complex susceptibility of $PrCu_6$ at the nuclear magnetic ordering transition.** Kiely, J.; Manley, T.; Weyhmann, W. (Univ. of Minnesota, Minneapolis). *Journal of Low Temperature Physics;* 67: No. 3-4, 291-300(May 1987).

The frequency-dependent complex susceptibility of $PrCu_6$ has been measured between 2 and 5 mK in the vicinity of the nuclear magnetic ordering transition. Critical slowing at the critical point is indicated by a large loss component at audio frequencies. The real and imaginary components of the impedance of a rod of $PrCu_6$ are consistent with a susceptibility of the Debye form. The relaxation time increases to about 100 μsec as the critical point is approached from higher temperatures.

1219 **Surface alloying by ion, electron and laser beams.** Rehn, L.E.; Picraux, S.T.; Wiedersich, H. Metals Park, OH; American Society for Metals (1986). 407p. (CONF-8510160—). American Society for Metals, Metals Park, OH 44073.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

This book presents the papers given at a conference on the surface treatments of alloys using ion, electron, and laser beams. Topics considered at the conference included energy deposition, heat flow, rapid solidification, physical radiation effects, ion implantation, ion-irradiated materials, microstructure, solute redistribution,

surface-melted alloys, solute trapping in ion-implanted metals, and the industrial applications of ion beam processes.

1220 **Solute trapping in ion-implanted metals.** Myers, S.M.; Follstaedt, D.M.; Besenbacher, F. (Sandia National Lab., Albuquerque, NM). pp 223-270 of Surface alloying by ion, electron and laser beams. Rehn, L.E.; Picraux, S.T.; Wiedersich, H. Metals Park, OH; American Society for Metals (1986). (CONF-8510160—). Contract AC04-76DP00789.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

Solutes in metals undergo trapping reactions with numerous entities that range from irradiation defects to the boundaries of precipitates. Such trapping is especially prevalent in ion-implanted alloys because of the high defect densities, refined microstructures, relatively low formation temperatures, and frequent use of interstitial solutes that typify these systems, and solute concentrations as high as several atomic percent may be involved; consequently, the effects on microstructure and macroscopic properties are often substantial. Although present knowledge of trapping mechanisms is far from complete, three developments in the past decade have yielded a degree of understanding that usually permits a qualitative interpretation of observations and sometimes leads even to quantitative predictions. These developments are the emergence of fairly extensive experimental results, the important improvements in theoretical calculations of solute-trap interactions, and the numerical solution of systems of equations that relate the properties of individual traps to the global evolution of implanted systems. The present review begins with a general and qualitative discussion of trapping behavior, and then moves to a more detailed consideration of the theoretical methods used to treat these effects. With this background, selected experimental studies are presented to develop general trends and to illustrate the experimental and theoretical procedures. The discussion concludes by considering implications of solute trapping for the microstructures and properties of ion-implanted alloys.

1221 **Microstructures of surface-melted alloys.** Follstaedt, D.M.; Picraux, S.T. (Sandia National Lab., Albuquerque, NM). pp 175-222 of Surface alloying by ion, electron and laser beams. Rehn, L.E.; Picraux, S.T.; Wiedersich, H. Metals Park, OH; American Society for Metals (1986). (CONF-8510160—). Contract AC04-76DP00789.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

The microstructures formed by rapid melting and solidification of surface alloys on metal substrates are described for fast laser- and electron-beam heating. Primary emphasis is placed on developing a general perspective on the materials science of rapid solidification. Surface melting produces controllable and calculable thermal histories, which allow quantitative evaluation of kinetic and thermodynamic alloy parameters affecting the mircrostructures produced by rapid solidification. The heating and cooling rates obtainable with surface melting (up to 10/sup 10/K/s) allow faster quenching regimes to be examined. The wide range of microstructures that can be accessed by surface melting is illustrated in turn for pure metals, ion-implanted surface alloys, deposited-layer alloys, and engineering alloys.

1222 **Solute redistribution under nonequilibrium conditions.** Rehn, L.E.; Wiedersich, H. (Argonne National Lab., Argonne, IL). pp 137-174 of Surface alloying by ion, electron and laser beams. Rehn, L.E.; Picraux, S.T.; Wiedersich, H. Metals Park, OH; American Society for Metals (1986). (CONF-8510160—). Contract W-31-109-ENG-38.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

Surface composition and microstructure play critical roles in determining the chemical, electrical, and mechanical interactions of an alloy with its environment. Because ions can deposit energy at high densities over very short time periods, ion beams can be used to circumvent many thermodynamic constraints and create high nonequilibrium alloy compositions and microstructures. In contrast, irradiation conditions can also be chosen in a manner which allows the attainment of equilibrium states that, in the absence of ion bombardment, require unacceptably long aging times. This unparalleled flexibility permits a wide variety of modified surface microstructures to be generated by ion beams. During migration, defect annihilation occurs whenever an opposite partner or defect sink is encountered. More importantly, however, defect migration redistributes the atoms within the material. This redistribution of alloying components, which determines the final microstructure, and therefore, the resultant property changes, is the primary focus of the present chapter. Since the number of point defects that are introduced during irradiation can exceed the number of injected ions by several orders of magnitude, point defect migration can be extremely efficient in altering alloy microstructures. This fact is well known within the fission and fusion materials communities but has received considerably less exposure in the materials modification area.

1223 **Atomic displacement processes in ion-irradiated materials.** Averback, R.S.; Kirk, M.A. (Argonne National Lab., Argonne, IL). pp 91-136 of Surface alloying by ion, electron and laser beams. Rehn, L.E.; Picraux, S.T.; Wiedersich, H. Metals Park, OH; American Society for Metals (1986). (CONF-8510160—). Contract W-31-109-ENG-38.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

The modification of a material by ion-beam irradiation can be achieved by various methods. The oldest method, ion implantation, has been used in the semiconductor industry for many years as a means to introduce electrically active impurities into devices in controlled ways; its use continues to expand. More recently, ion implantation is being employed for other technological applications, such as the improvement of the tribological properties of metals and ceramics. The main process involved in ion implantation is the introduction of foreign atoms into a material in order to change the composition of the surface region. However, as ion implantors quickly learned, implantation also leads to radiation damage, that is, the production of structural defects. For the semiconductor industry, radiation damage was only of interest insofar as being able to anneal the damage out. It is now recognized that the atomic displacement process involved in producing defects can be employed as a modification process in itself. For example, ion irradiation can be used for producing metastable phases such as amorphous phases at the surfaces of bulk alloys. Surfaces can be bombarded during vapor deposition to modify growing phases or enhance adhesion. Finally, ion-beam mixing processes can be used to mix multilayer specimens in order to produce surface alloys of high solute concentration where implantation is impractical. Intrinsic to all ion-beam modification procedures are the fundamental displacement processes in irradiated materials, which is the subject of this chapter.

1224 **Kinetics of resolidification.** Perepezko, J.H.; Boettinger, W.J. (Univ. of Wisconsin-Madison, Madison, WI). pp 51-90 of Surface alloying by ion, electron and laser beams. Rehn, L.E.; Picraux, S.T.; Wiedersich, H. Metals Park, OH; American Society for Metals (1986). (CONF-8510160—).

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

While ion-, laser-, and electron-beam surface treatments involve a variety of experimental conditions, they share some important, common kinetic and thermodynamic features. The alloy additions incorporated in the surface-modified solid region by the various processes are often in metastable states of relatively high free energy. An examination of the metastable equilibrium features of phase diagrams can identify the possible choice of product structures depending on the particular constraints imposed on the system and the controlling phase selection kinetics during nucleation. The analysis of resolidification under rapid rates involves the use of response functions to treat the liquid-solid interface conditions during solute trapping. These functions, when combined with solute redistribution and heat flow analysis, provide a basis for the prediction and analysis of microstructural evolution in surface-treated layers in terms of scale and morphology. The application of metastable equilibria and kinetic analyses offers an effective strategy for the generation of microstructure tailored to optimize the results of surface treatments.

1225 **Energy deposition, heat flow, and rapid solidification during pulsed-laser- and electron-beam irradiation of materials.** White, C.W.; Aziz, M.J. (Oak Ridge National Lab., Oak Ridge, TN). pp 19-50 of Surface alloying by ion, electron and laser beams. Rehn, L.E.; Picraux, S.T.; Wiedersich, H. Metals Park, OH; American Society for Metals (1986). (CONF-8510160—). Contract AC05-84OR21400.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

The fundamentals of energy deposition, heat flow, and rapid solidification during energy deposition from laser and electron beams are reviewed. Emphasis is placed on the deposition of energy from pulsed sources (10-100-ns pulse duration time) in order to achieve high heating and cooling rates (10/sup 8/-10/sup 10/ °C/s) in the near-surface region. The response of both metals and semiconductors to pulsed energy deposition is considered. Guidelines are presented for the choice of energy source, wavelength, and pulse duration time.

1226 **Overview of surface alloying by ion, electron, and laser beams.** Rehn, L.E.; Picraux, S.T.; Wiedersich, H. (Argonne National Lab., Argonne, IL). pp 1-18 of Surface alloying by ion, electron and laser beams. Rehn, L.E.; Picraux, S.T.; Wiedersich, H. Metals Park, OH; American Society for Metals (1986). (CONF-8510160—). Contract W-31-109-ENG-38.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

Surface composition and microstructure play critical roles in determining the usefulness of many technological materials. For example, the mechanical interactions of an alloy with its environment such as friction and wear, chemical effects such as oxidation and corrosion, and even its outward appearance are all controlled by the properties of a very thin layer of material at the surface. For this reason, the properties required at the surface of an alloy for a given application are often different from, and frequently even incompatible with, property requirements for the bulk material. This constraint has spawned a great variety of traditional surface alloying and coating techniques, ranging from the simple application of paints, to considerably more sophisticated electroplating, nitriding, and surface diffusion treatments. In favorable circumstances, surface alloying can be used to independently optimize the surface and bulk properties of a material for a given application. Unfortunately, equilibrium solubility limits and low solid-state diffusivities impose severe restrictions on conventional surface alloying methods, and problems of adhesion frequently plague coating techniques.

1227 **Effects of adsorbates on electron spin polarization in low energy electron diffraction from tungsten (001). II. Ordered CO overlayer.** Riddle, T.W.; Mahan, A.H.; Dunning, F.B.; Walters, G.K. (Rice Univ., Houston, TX). *Surface Science;* **82**: 517-524(1979).

Electron spin polarization and intensity profiles have been measured in low electron diffraction (LEED) for the (OO) beam at theta = 13° and phi = 0° from a W(001) surface exposed to CO and annealed to obtain an ordered c(2 x 2) CO overlayer. The annealed surface with additional CO adsorbed was also studied. The polarization was found to be sensitive to the surface condition and the very distinct P-V profile corresponding to the c(2 x 2) overlayer is believed to be a very sensitive indicator of CO in the $\beta 3$ phase. The properties of the annealed surface exposed to further CO suggest the use of this surface as a low energy electron spin polarization analyzer. 12 references, 3 figures.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 1148, 1149, 1149, 1182, 1223, 1225, 1414, 1469, 1470, 1471, 1472, 1656

1228 **(AD-A—183174/2/XAB) Application of computer methods for calculation of multicomponent phase diagrams of high-temperature structural ceramics. Final report, August 1984-July 1987.** Kaufman, L. (Manlabs, Inc., Cambridge, MA (USA)). 31 Jul 1987. 99p. NTIS, PC A05/MF A01.

A data base is being developed for calculation of quasi-binary and quasi-ternary phase diagrams of ceramic systems. Previous segments of this base cover combinations of Cr_2O_3, MgO, Al_2O_3, SiO_2, CaO, Si_3N_4, AlN, BeO, Y_2O_3 and Ce_2O_3. Sixty -six quasi binary and nineteen quasi ternary systems have been calculated. Current work extends the base to cover GeO_2, HfO3, ZrO_2 and TiO_2 which are of interest in applications requiring toughness and structural performance at high temperatures. This has been effected by employing available source of thermochemical and phase-diagram data. Recently it has been shown that by alloying GeO_2 with SiO_2 a whole range of glasses can be synthesized with tailor-made coefficients of expansion. Utilization of such compositions offers the possibility of enhancing the high temperature oxidation resistance of ceramic composites in which a mixed GeO_2-SiO_2 phase which a desired CTE would replace the conventional SiO_2 as a filler.

1229 **(INIS-BR—750) Thermally stimulated currents in ZrO/sub 2/:MgO.** Muccillo, E.N.S. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). [1987]. 11p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703501/JAW.

Thermally Stimulated Depolarization Current measurements between 100 K and 350 K have been performed in ZrO/sub 2/:MgO ceramic samples to discriminate the several Kinds of polarization (orientational and interfacial polarization, and extrinsic and intrinsic space charge effects) to allow for the use of the technique in the study of solid solution formation in partially stabilized zirconia. The samples were prepared by conventional ceramic processing methods. Different electrode materials have been used: colloidal graphite, silver, gold, and also insulating electrodes (e.g. mylar foils). The current spectra obtained are strongly dependent upon the electrode material showing the presence of spacial charge phenomenon in these ceramics.

1230 **(LA-UR—87-3149) Synthesis of the monoclinic yttria by thermal plasma processing.** Vogt, G.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 17p. (CONF-871027—34). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000496/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Submicron powders of monoclinic yttria were prepared by thermal plasma processing of commercial yttria powder. The starting yttria powder was vaporized in the hot tail flame of a thermal argon plasma and the resulting vapor was quenched with hydrogen gas to form yttria particles with a 21-nm mean diameter. The synthesis of yttria by oxidizing yttrium carbide in the plasma was also examined. The plasma powders were characterized by powder x-ray diffraction, transmission electron microscopy, and differential thermal analysis. 13 refs., 4 figs., 4 tabs.

1231 **(LBL—23531-Rev.) Magnetic field dependence of the specific heat of some high-T/sub c/ superconductors.** Phillips, N.E.; Fisher, R.A.; Lacy, S.E.; Marcenat, C.; Olsen, J.A.; Ham, W.K.; Stacy, A.M. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 6p. (CONF-870873—8-Rev.). NTIS, PC A02. Order Number DE87014078/JAW.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

This paper investigates the effect of magnetic fields on the specific heat of some high-T/sub c/ superconductors. Measurements of specific heat, C, were made on samples of La_2CuO/sub 4-y/ (La1), La/sub 1.85/M/sub 0.15/CuO/sub 4-y/ (Ca1, Sr1, Sr2, Ba1 and Ba2) and YBa_2Cu_3O/sub 9-y/ (Y1). Meissner effect measurements were made in 12.5G. The high-temperature onset of a change in magnetic susceptibility, chi, was taken as T/sub c/, and the transition width, ΔT/sub c/, as the temperature interval of the 10 to 90% change in chi. Calculation of the fractional Meissner effect, -4π chi/sub V/, was based on the total sample volume, with chi/sub V/ corrected for demagnetizing effects. 5 refs.

1232 **(N—87-25476) Stability and rheology of dispersions of silicon nitride and silicon carbide. Final report.** Feke, D.L. (Case Western Reserve Univ., Cleveland, OH (USA)). Jun 1987. 74p. (NASA-CR—179634; NAS—1.26:179634). NTIS, PC A04/MF A01.

The relationship between the surface and colloid chemistry of commercial ultra-fine silicon carbide and silicon nitride powders was examined by a variety of standard characterization techniques and by methodologies especially developed for ceramic dispersions. These include electrokinetic measurement, surface titration, and surface spectroscopies. The effects of powder pretreatment and modification strategies, which can be utilized to augment control of processing characteristics, were monitored with these technologies. Both silicon carbide and nitride were found to exhibit silica-like surface chemistries, but silicon nitride powders possess an additional amine surface functionality. Colloidal characteristics of the various nitride powders in aqueous suspension is believed to be highly dependent on the relative amounts of the two types of surface groups, which in turn is determined by the powder synthesis route. The differences in the apparent colloidal characteristics for silicon nitride powders cannot be attributed to the specific absorption of ammonium ions. Development of a model for the prediction of double-layer characteristics of materials with a hybrid site interface facilitated understanding and prediction of the behavior of both surface charge and surface potential for these materials. The utility of the model in application to silicon nitride powders was demonstrated.

1233 **(N—87-26233) Composition optimization of chromium carbide based solid lubricant coatings for foil gas bearings at temperatures to 650 C. Final contractor report.** Dellacorte, C. (Case Western Reserve Univ., Cleveland, OH (USA)). Jul 1987. 20p. (NASA-CR—179649; E—3681; NAS—1.26:179649). NTIS, PC A02/MF A01.

A test program to determine the optimum composition of chromium carbide based solid lubricant coatings for compliant gas bearings is described. The friction and wear properties of the coatings are evaluated using a foil gas bearing test apparatus. The various coatings were prepared by powder blending, then plasma sprayed onto Inconel 718 test journals and diamond ground to the desired coating thickness and surface finish. The journals were operated against preoxidized nickel-chromium alloy foils. The test bearings were subjected to repeated start/stop cycles under a 14 kPa (2 psi) bearing unit load. The bearings were tested for 9000 start/stop cycles or until the specimen wear reached a predetermined failure level. In general, the addition of silver and eutectic to the chromium carbide base stock significantly reduced foil wear and increased journal coating wear. The optimum coating composition, PS212 (70 wt% metal bonded Cr3C2, 15 wt% Ag, 15% BaF2/CaF2 eutectic), reduced foil wear by a factor of two and displayed coating wear well within acceptable limits. The load capacity of the bearing using the plasma-sprayed coating prior to and after a run-in period was ascertained and compared to polished Inconel 718 specimens.

1234 **(N—87-26362) Ultrasonic NDE of structural ceramics for power and propulsion systems.** Vary, A.; Generazio, E.R.; Roth, D.J.; Baaklini, G.Y. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 12p. (NASA-TM—100147; E—3705; NAS—1.15:100147; CONF-8709161—). NTIS, PC A02/MF A01.

From 4. European conference on non-destructive testing; London, UK (13 Sep 1987).

A review of research investigations of several ultrasonic evaluation techniques applicable to structural ceramics for advanced heat engines is presented. This review highlights recent work conducted under the sponsorship of and at the Lewis Research Center. Results obtained with scanning acoustic microscopy, scanning laser acoustic microscopy, photo acoustic microscopy, and scanning electron acoustic microscopy are compared. In addition to these flaw imaging techniques, microstructure characterization by analytical ultrasonics is described. The techniques were evaluated by application to research samples of monolithic silicon nitride and silicon carbide in the form of discs and bars containing naturally occurring and deliberately-introduced flaws and microstructural anomalies. Strengths and limitations of the techniques are discussed.

1235 **(PNL-SA—14794) Real-time Raman detection of molecular changes in ceramics undergoing sliding friction.** Exarhos, G.J.; Donley, M.S. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 13p. (CONF-870725—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000558/JAW.

From 22. annual meeting of the Microbeam Analysis Society; Kailua-Kona, HI, USA (13 Jul 1987).

Time-resolved Raman spectroscopy was used to probe the wear track caused by contact between a rotating ceramic disk (boron nitride or silicon carbide) and either a steel ball bearing or a silicon carbide wedge. The visco-elastic response of the hexagonal phase of boron nitride, which is used as a solid lubricant, was evaluated on a millisecond timescale. Vibrational spectra indicate that this material actually becomes a better lubricant under conditions of increased force between the wear tip and spinning disk. Similar studies involving wear between a silicon carbide disk and silicon carbide wear tip indicated that decomposition and/or segregation of elemental silicon and carbon occurred at high wear rates. The surface temperature near the wear tip was determined from measured vibrational spectra and the temperature profile around the wear track was evaluated. Evidence for oxidation of carbon at the surface was inferred from measured spectra. Application of this laser-based technique to tribological studies provides information relating to localized heating, relaxation dynamics, and phase transformation/decomposition phenomena useful for understanding the fundamental mechanisms of friction and wear.

1236 **(SAND—87-2098C) Molecular engineering of ceramics.** Martin, J.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-870878—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000174/JAW.

From Conference on atomic and molecular processing of electronic and ceramic materials: preparation, characterization and properties; Seattle, WA, USA (31 Aug 1987).

We discussed some recent advances in the study of silica sol-gels, including the kinetics of growth of the sol beneath the gel point, the fractal structure of the sol and the observation of a spatial correlation length in undiluted gels. We attempted to connect these results to popular theories, but were not able to paint a definitive picture of the sol-gel transition. In part, this is due to the paucity of experimental data in this field. A few tentative conclusions can be drawn: (1) The static structure of the fractionated and unfractionated sol seems to be fairly well accounted for by the percolation model if swelling is taken into account. (2) The divergences of the average cluster mass and radius are stronger than predicted by the percolation model, and much stronger than the Flory-Stockmayer predictions. (3) The static structure observed in the undiluted, low-density silica gels are in reasonable agreement with either an equilibrium model, such as correlated percolation, or a kinetic growth model. Discrepancies exist in either case. 16 refs., 5 figs.

1237 **Titanium-oxygen reaction at the Ti/La/sub 1.85/ Sr/sub 0.15/CuO_4 interface.** Meyer H.M. III; Hill, D.M.; Anderson, S.G.; Weaver, J.H.; Capone D.W. II. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Applied Physics Letters;* **51**: No. 21, 1750-1752(23 Nov 1987).

High-resolution x-ray photoemission has been used to study the reaction between vapor deposited Ti and La/sub 1.85/Sr/sub 0.15/CuO_4. For low Ti coverages we observe a sharp decrease in electron emission within ~2 eV of the Fermi level because of disruption of hybrid Cu 3d/sub x//sub <2/-y/sup =/-O 2p/sub x// sub ,//sub y/ orbitals, the loss of metallic character of the surface region, and the loss of superconductivity. Ti 2p and O 1s core level results show that oxygen is removed from the superconductor to form TiO_2 at low coverages. At higher coverage, the reaction becomes diffusion limited; a Ti-rich oxide or solution grows. The Cu $2p_{3}$/sub //$_{2}$ emission shows that oxygen withdrawal rapidly reduces the Cu^{2+} configuration. Ti metal forms after ~10 A deposition.

1238 **Single-layer TiO_2 and multilayer TiO_2—SiO_2 optical coatings prepared from colloidal suspensions.** Thomas, I.M. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550). *Applied Optics;* 26: No. 21, 4688-4691(1 Nov 1987). Contract W-7405-ENG-48.

Single-layer coatings on fused silica substrates have been prepared from aqueous colloidal suspensions of titania at room temperature. These coatings were porous and had a refractive index of 1.9. Multilayer high reflectivity dielectric coatings were also prepared by laying down quarterwave thick alternating coats at room temperature of this titania with silica, prepared from a colloidal suspension of silica. Single-shot laser damage threshold measurements at 1064-nm wavelength with a pulse length of 1 ns were carried out for both the titania and titania—silica systems. These averaged 7.5 and 6.2 J/cm², respectively.

1239 **Reoxygenation of vacuum-annealed YBa_2Cu_3O/sub 6.9/.** Ginley, D.S.; Nigrey, P.J.; Venturini, E.L.; Morosin, B.; Kwak, J.F. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Materials Research;* 2: No. 6, 732-735(Nov 1987). Contract AC04-76DP00789.

Vacuum-annealed samples of single-phase orthorhombic YBa_2Cu_3O/sub 6.9/ have been reoxygenated. The vacuum-annealed material is tetragonal, semiconducting at room temperature, and shows no superconductivity. Upon annealing these samples in 640 Torr O_2 at 200 °C, a partial return of 90 K superconductivity is observed; complete restoration is achieved following 300 °C anneals. Oxygen uptake in vacuum-annealed pellets follows an Arrhenius relation with an activation energy of -27 kcal/mol. Deoxygenation and reoxygenation does not seem to affect the structure of the grain interconnects in the material. The maximum oxygen uptake for vacuum-annealed material occurs at 450 °C, while the maximum magnetic Meissner effect is observed following oxygen annealing at 350 °C.

1240 **Magnetization studies of the high-T/sub c/ compound $Y_1Ba_2Cu_3O$/sub x/.** Thompson, J.R.; Christen, D.K.; Sekula, S.T.; Brynestad, J.; Kim, Y.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6061 and Department of Physics, University of Tennessee, Knoxville, Tennessee 37996-1200). *Journal of Materials Research;* 2: No. 6, 779-782(Nov 1987). Contract AC05-84OR21400.

The superconductive state magnetization of the high-T/sub c/ compound $Y_1Ba_2Cu_3O$/sub z/ has been investigated. Single-phase, polycrystalline samples of this archetype were prepared by solid-state reaction. The onset of the superconductive transition, measured magnetically, was 90.7 K. In addition to low-field dc magnetization results, measurements of the magnetic critical current density J/sub c/(H,T) are presented as a function of magnetic field and temperature. The low values of J/sub c/, especially at high temperature, are discussed in terms of intergranular supercurrents that flow within individual grains in superconductive layers of reduced dimensionality.

1241 **Pressure dependence of the superconducting transition temperatures in La/sub 1.85/Sr/sub 0.15/CuO_4 to 8 GPa.** Erskine, D.; Hess, E.; Yu, P.Y.; Stacy, A.M. (Department of Physics, University of California and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Materials Research;* 2: No. 6, 783-785(Nov 1987). Contract AC03-76SF00098.

Pressure dependence of the superconducting transition temperature in La/sub 1.85/Sr/sub 0.15/CuO_4 has been measured to 8 GPa using a diamond anvil cell. The experimental results are discussed within the conventional electron—phonon model of superconductivity.

1242 **Mechanisms of high-T/sub c/ superconductivity in low-dimensional materials.** Kresin, V.Z. (Materials and Chemical Sciences Division, Lawrence Berkely Laboratory, University of California, Berkeley, California 94720). *Journal of Materials Research;* 2: No. 6, 793-799(Nov 1987).

High-T/sub c/ superconductivity is due to the action of two mechanisms: (1) plasmon mechanism, i.e., exchange of two-dimensional (2-D) plasmons and (2) strong electron—phonon coupling. The low dimensionality and the small value of the carrier concentration make the plasmon mechanism favorable. The small value of the coherence length leads to a unique opportunity to observe a multigap structure. The proximity effect can be used in order to increase T/sub c/ of A-15 compounds.

1243 **Luminescent properties of x-irradiated rare-earth-doped barium copper oxides.** Cooke, D.W.; Rempp, H.; Fisk, Z.; Smith, J.L.; Jahan, M.S. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Materials Research;* 2: No. 6, 871-875(Nov 1987).

Thermally stimulated luminescence (TSL) of x-ray-induced defects in R—Ba—Cu—O (R = Gd, Ho, and Eu) has been measured. In the interval 25—400 °C, Ho- and Eu-doped samples exhibit similar TSL with peaks at 65, 135, and 185 °C. The $GdBa_2Cu_3O$/sub x/ has, in addition to the three aforementioned peaks, a maximum at 310 °C. All TSL peaks are attributed to recombination of F^+/sub s/- and F/sub s/- center electrons with V/sub s/- type holes, requiring typical thermal activation energies 0.5—1.0 eV. Spectral emission data support this conclusion. Irreversible quenching of TSL is found to occur in each sample. It is postulated that adsorbed oxygen molecules interact with radiation-induced F^+/sub s/ and F/sub s/ centers to produce O^-_2 and O/sup 2-/$_2$ molecular ions, respectively, thereby reducing the surface oxygen vacancy concentration and quenching the luminescence. In addition to activation energies, other TSL parameters are extracted from the data. It is suggested that surface TSL in these oxide superconductors is independent of rare-earth dopant.

1244 **(N—87-25479) Strengthening phosphate ceramic foam by silicon carbide whiskers.** Schetanov, B.V.; Prilepskiy, V.N.; Lapidovskaya, L.A.; Chernyak, A.I.; Romanovich, I.V. Translated from *Mekhanika Kompozitnykh Materialov ;* No. 2, 253-256(Jul 1987). 9p. (NASA-TT—20025; NAS—1.77:20025). NTIS, PC A02/MF A01.

The influence of additions of SiC whiskers on the elastic modulus and flexural strength of phosphate ceramic foam is assessed. It is shown that the incorporation into the material composition of even small amounts (2.4 vol%) of SiC whiskers enhances the impact toughness and heat resistance of the ceramic foam. A 12.3 vol% of SiC whiskers leads to a more than threefold increase of the flexural strength. Strengthening of the phosphate ceramic foam is due to the fact that the whiskers hinder the propagation of matrix crack by increasing the work of matrix fracture. The whiskers reinforce only that volume of material which is occupied by solid matter, whereas they do not reinforce the pores.

1245 **Comparative critical field study of superconducting ternary borides.** Lee, W.H.; Appl, S.; Shelton, R.N. (Dept. of Energy, Ames, IA). *Journal of Low Temperature Physics;* 68: No. 1-2, 147-157(Jul 1987). Contract W-7405-ENG-82.

The upper critical field (H/sub c2/) and electrical transport properties have been determined for ternary rare-earth transition-metal borides with a variety of crystal structures; namely, $ScRu_4B_4$ ($I4_1/acd$), $ThRh_4B_4$ ($P4_2/nmc$), $LuOs_3B_2$ (P6/mmm), $LuRuB_2$(Pnma), and $YRuB_2$ (Pnma). For the majority of the compounds the critical field measurements are analyzed in terms of the dirty limit [/sub tr//zeta/sub BCS/(0) << 1] theory of Werthamer, Helfand, and Hohenberg (WHH). For the superconductor $YRuB_2$, which is in the clean limit, critical field data are analyzed in terms of the Ginzburg-Landau theory. From the experimental data for (dH/sub c2//dT)/sub T = T/sub c//, T/sub c/, and residual resistivity rho/sub res/, they also have determined the heat capacity coefficient γ and BCS coherence length zeta/sub BCS/(0). The kappa values indicate that these compounds are all strong type II superconductors.

1246 **Method for hot pressing beryllium oxide articles.** Ballard, A.H.; Godfrey, T.G. Jr.; Mowery, E.H. (to Dept. of Energy). US Patent Application 6-917,460. 10 Oct 1986. 14p. Contract AC05-84OR21400. DE88000875 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000875/JAW.

The hot pressing of beryllium oxide powder into high density compacts with little or no density gradients is achieved by em-

ploying a homogeneous blend of beryllium oxide powder with a lithium oxide sintering agent. The lithium oxide sintering agent is uniformly dispersed throughout the beryllium oxide powder by mixing lithium hydroxide in an aqueous solution with beryllium oxide powder. The lithium hydroxide is converted in situ to lithium carbonate by contacting or flooding the beryllium oxide - lithium hydroxide blend with a stream of carbon dioxide. The lithium carbonate is converted to lithium oxide while remaining fixed to the beryllium oxide particles during the hot pressing step to assure uniform density throughout the compact.

3606 Other Materials

REFER ALSO TO CITATION(S) 269, 348, 459, 467, 479, 490, 491, 493, 502, 503, 504, 505, 506, 508, 534, 709, 711, 712, 713, 714, 716, 717, 718, 720, 721, 723, 729, 731, 1168, 1186, 1225, 1228, 1321, 1450, 1461, 1475, 1475, 1509, 1516, 1517, 1519, 1519, 1544, 1618, 1650, 1659, 2635, 2642, 2643, 2644, 2645, 2651, 2652, 2655, 2685

1247 (AD-A—182744/3/XAB) Determination of electrical properties of grounding, bonding, and fastening techniques for composite materials. Final report, September 1984-December 1985. Cooley, W.W. (Science and Engineering Associates, Inc., Seattle, WA (USA)). Apr 1987. 88p. NTIS, PC A05/MF A01.

This report documents the results from a limited study of Electrical Parameters of Composite Materials. These efforts provided an evaluation of grounding and bonding test methods for metal, metal honeycomb, and advanced composite materials. A review of the electrical currents in the bonding and grounding paths on aircraft concluded that the lightning environment is the most severe followed by power system faults and on-board HF radio. It is recommended that the conventional 2.5 milliohm grounding and bonding requirement may be relaxed providing that special tests are conducted on the structure and subassemblies that enter into the grounding and bonding current paths. These tests are defined and recommendations made for advanced structures. A limited analysis of published test results concluded that good agreement may be possibly between predicted values and test results for complete structures, subassemblies, and components.

1248 (AD-A—182931/6/XAB) Effects on advanced materials: results of the STS-8 EOIM (effects of oxygen interaction with materials) experiment. Meshishnek, M.J.; Stuckey, W.K.; Evangelides, J.S.; Feldman, L.A.; Peterson, R.V. (Aerospace Corp., El Segundo, CA (USA). Materials Sciences Lab.). 20 Jul 1987. 89p. (TR—0086(6935-05)-2). NTIS, PC A05/MF A01.

A variety of materials were exposed to the low-Earth-orbit space environment on shuttle flight STS-8 as a part of NASA's Effects of Oxygen Atoms Interaction with Materials experiment. These materials include carbon and graphites, optical materials, organic and metal films, Kevlar and fiberglass fabric, and high-temperature coatings. The effects noted on these materials included oxidative erosion of the carbon and graphite, loss of tensile strength for the Kevlar fabric, erosion and oxidation of organic films, partial oxidation of infrared optical materials, and loss of reflectance for the high-temperature coatings.

1249 (AD-A—183151/0/XAB) Radiolysis of poly(chloroacetaldehyde), a positive e-beam resist. Technical report. Chien, J.C.; Lu, P.H. (Massachusetts Univ., Amherst (USA). Dept. of Polymer Science and Engineering). Jun 1987. 36p. (TR—5). NTIS, PC A03/MF A01.

The gamma radiolysis and deep-ultraviolet photolysis of poly(chloroacetaldehyde), PCA, caused efficient depolymerizations at ambient temperature. The processes are promoted by oxygen; the G(m) value (number of monomer produced per 100 eV absorbed) is 11,000 in the presence of air. The chain scission yield is also high (G(s)=5.5) without crosslinking (G(x)=0). These processes are much less efficient in vacuo; G(m)=1,100, G(s) = 1100, G(s) = 2.1, G(x) = 0. Depolymerizations stop short of completion due to repolymerization of monomer formed. Bu4NBr has no effect on the gamma-induced depolymerization but 2,6-di-t-butyl-p-cresol retards it suggesting the participation of free radicals rather than ionic species in the processes. This interpretation is supported by electron spin resonance evidences. PCA is highly susceptible to degradation by plasma. However, this susceptibility can be suppressed by DUV crosslinking of PCA with bis(azidoformates) prior to plasma exposure. Halogen-containing polymers possessing low ceiling temperature may find usages as self-developing plasma-etchable positive resists.

1250 (AD-A—183225/2/XAB) Determination of amorphous layer thickness in ion-implanted silicon using secondary ion-mass spectrometry. Technical report. Hodul, D.T.; Smith, H.E.; Morrison, G.H. (Cornell Univ., Ithaca, NY (USA). Baker Lab.). Dec 1986. 10p. (TR—23). NTIS, PC A02/MF A01.

Pub. in Jnl. of Vacuum Science and Technology A, Vol. 4, No. 6, 2492-2498(Nov-Dec 1986).

Secondary ion mass spectrometry was used to study boron-doped Si (100) that was rendered amorphous by the implantation of ^{75}As. Using oxygen bombardment and negative secondary ion detection, all secondary ion species show a shift in ion energy of greater than 2 eV upon sputtering through the amorphous layer and into the underlying crystalline silicon. After regrowth of the same specimens by rapid thermal annealing, the secondary-ion energy shift occurs significantly deeper, at approximately the p-n junction. In both specimens, the energy shift was shown to be due to bombardment-induced specimen charging. Thus, the thickness of the amorphous layer in the As-implanted specimen can be determined by profiling with a narrow secondary-ion energy window. Mechanisms for this effect are discussed.

1251 (AD-A—183273/2/XAB) Kevlar photochemical degradation mechanisms. Final report, 1 October 1983-30 April 1986. Toy, M.S. (Science Applications International Corp., Sunnyvale, CA (USA)). Apr 1987. 38p. NTIS, PC A03/MF A01.

The objective of this program was to investigate and determine Kevlar's photochemical degradation mechanisms, rate constants, and activation energies in air. The underlying reason was to understand the oxidative photodegradation processes, which would help to provide service life forecast under the sunlight conditions and to aid effective method development against its photodecomposition. The first significant accomplishment of the project was the new and novel analytical approach, which demonstrated the rate constant and activation energy determinations of Kevlar's photooxidative processes. The 0.2 atm of oxygen-18-labeled environment in a solar chamber simulates the air exposure under sunlight conditions. The technique also allows the radial ^{18}O distribution measurement from the fiber surface toward the fiber center. The data from the accelerated experimental conditions in the solar chamber in an diatomic ^{18}O atmosphere are differentiated from the similar ambient daylight exposure effects. The second significant accomplishment was the recognition of a thermal-decomposition pattern of Kevlar in concentrated sulfuric acid at 196 C to give the same two types of decarboxylations: one yields one mole of carbon dioxide per (C_7H_5NO) moiety and the other gives two moles of CO_2 per (C_7H_5NO) moiety. The third significant accomplishment was the analytical methodology applied to deduce the four photooxidative processes.

1252 (BNL—40226) Single crystal neutron diffraction analysis of the cation distribution in the high temperature phases α-Cu/sub 2-x/S, α-Cu/sub 2-x/Se, and α-Ag_2Se. Oliveria, M.; McMullan, R.K.; Wuensch, B.J. (Brookhaven National Lab., Upton, NY (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 1987. Contract AC02-76CH00016. 15p. (CONF-8709116—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014915/JAW.

From 6. international conference on solid state ionics; Garmisch-Partenkirchen, F.R. Germany (6 Sep 1987).

The distribution and thermal vibration of the mobile cations have been studied for α-Cu/sub 2-x/S (200°C), α-Cu/sub 2-x/Se (160, 210, and 360°C), and α-Ag_2Se (135, 150, 200, and 300°C). Both α-Cu/sub 2-x/S and α-Cu/sub 2-x/Se, space group Fm3m, have an fcc anion array within which anharmonically-vibrating Cu atoms are displaced from the centers of the tetrahedra towards the vacant octahedral interstices. α-Ag_2Se, space group Im3m, has Se

in bcc packing and displays a cation distribution which is delocalized in channels along <100> similar to β-Ag_2S. Local maxima in the Ag density occur in pairs about the center of the tetrahedral interstice. 14 refs., 2 figs., 3 tabs.

1253 **(CEA-CONF—8865) Absorption and atom mobility in electric field: point defect role in glasses.** Serruys, Y.; Vigouroux, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Oct 1986. 12p. (In French). (CONF-8610294—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752910/JAW.

From Seminar on surface analysis; Cadarache, France (14 Oct 1986).

During the surface analysis of dielectric materials, the impinging ionising particles induce point defects localised in the band gap and build an electrical charge. The electric field created by the charged defects modifies the physico-chemical properties of surface and bulk. We show that the fundamental study of defects allows a better understanding of technological phenomena such as dielectric breakdown, fracture and diffusion.

1254 **(CEA-CONF—8935) Breakdown, fractoemission, diffusion: role of defects in dielectrics.** Vigouroux, J.P.; Serruys, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Jan 1987. 6p. (In French). (CONF-870179—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752753/JAW.

From Winter school on surface physical-chemistry and technologies; Les Menuires, France (6 Jan 1987).

During the surface analysis of dielectric materials, the impinging ionising particles induce point defects localised in the band gap and build an electrical charge. The electric field created by the charged defects modifies the physico-chemical properties of surface and bulk. We show that the fundamental study of defects allows a better understanding of technological phenomena such as dielectric breakdown, fracture and diffusion.

1255 **(DOE/ER/13184—1) Thermal stress microfracturing in granite: Technical report for period May 16, 1986-July 15, 1987.** Wang, H.F. (Wisconsin Univ., Madison (USA)). Sep 1987. Contract FG02-84ER13184. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000400/JAW.

A comprehensive experimental capability to understand thermally induced microfractures in rock has been developed. Acoustic emissions are counted and compressional wave velocities are measured while a sample is heated to a maximum temperature of 350°C under confining pressures up to 55 MPa. After a heating cycle, crack porosity and crack compressibility are measured. The samples have been dissected and the cracks have been counted and sorted by grain boundary, intragranular types, and mineral pair occurrence. For granites, it has been established that most newly created thermal cracks close at pressures less than 40 MPa (1.5 km depth); crack porosity increases exponentially with temperature for any given pressure; quartz grain boundaries are preferentially cracked; the onset of acoustic emissions is a linear function of pressure in agreement with micromechanical inclusions theories; and total acoustic emission counts over the temperature range 20 to 300°C decrease by factors between 2 and 5 per 28 MPa increase in confining pressure, with the decrease most dramatic for the initial increments of pressure.

1256 **(DOE/ER/45067—T1) Novel dynamical investigations of excitons and their structure in semiconductors: Final report for period June 1984-November 1986.** Nurmikko, A.V. (Brown Univ., Providence, RI (USA). Div. of Engineering). Aug 1987. Contract FG02-84ER45067. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014868/JAW.

In this document, two spectroscopic investigations in the time dependent behavior of excitons in selected semiconductors are discussed. First, as a continuation of previous grant work, issues of energy dependent exciton-exciton scattering in a model bulk semiconductor Cu_2O have been studied. Picosecond photomodulation methods have yielded for the first time direct kinetic information about scattering involving the 1S and 2P exciton states. Second, exciton formation and localization kinetics have been investigated through time-resolved photoluminescence in a new wide bandgap semiconductor quantum well structure, based on the ZnSe/(Zn,Mn)Se heterojunction. In this case exciton formation and recombination rates have been shown to also depend on an additional energy relaxation channel into the Mn-ion d-electron excitations.

1257 **(ETN—87-99757) Deep level transient spectroscopy investigation of sputter deposited Mo-GaAs Schottky barriers.** Moccia, G.; Magrini, F.; Cetronio, A. (Selenia S.p.A., Rome (Italy)). 1986. 10p. (CONF-8606344—1). NTIS, PC A02/MF A01.

From 13. advanced materials for telecommunication conference; Strasbourg, France (17 Jun 1986).

Deep level transient spectroscopy investigation reveals how the sputter deposition process can greatly influence the characteristics of Mo-GaAs Schottky barriers. It is found that the damage introduced during deposition cannot be completely eliminated by annealing at 450 C for 1hr and as such stringent control of the deposition parameters is necessary if near ideal barriers are to be fabricated by this technique.

1258 **(FRCEA-TH—16) Study of SmS properties in the low pressure phase (black phase).** Bordier, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; Paris-11 Univ., 91 - Orsay (France)). 1986. 162p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87752723/JAW.

SmS was studied for the transition from low pressure phase (black phase) to high pressure phase with an intermediate valence. But the study of the black phase is very rich. The variations of electron transport properties with pressure at low temperature show a semi-metal phase located, in the pressure-temperature diagram in the black phase for pressure over 4 kbars, corresponding to the phase B'of the doping-temperature diagram. Electron spin resonance shows a lack of sulfur and nearby this defect a samarium ion, magnetically coupled with the matrix, presents a divalent trivalent transition. Resonance lines are broadened with temperature. Conductivity relaxations occur at low pressure and low temperature by trapping a conduction electron, by magnetic exchange giving a bounded magnetic polaron. The relaxation time at null magnetic field is activated. An approximation of trapping barrier and critical field corresponding the maximum magnetoresistance is given by a model.

1259 (JAERI-M—86-192, pp 138-143) **Effects of high temperature neutron irradiation on the physical, chemical and mechanical properties of fine-grained isotropic graphite.** Matsuo, H.; Nomura, S.; Imai, H.; Oku, T.; Eto, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

Effects of neutron irradiation on the dimensional change, coefficient of thermal expansion(CTE), thermal conductivity, corrosion rate, Young's modulus and strengths were studied for the candidate graphite material IG-110 of the experimental very high temperature gas-cooled reactor(VHTR) after irradiation at 585 - 1273 deg C to neutron fluences of up to about 3 x 10/sup 25/ n/m/sup 2/ (E > 29 fJ) in the JMTR and JRR-2, and to about 7 x 10/sup 25/ n/m/sup 2/ (E > 29 fJ) in the HFR. The results were compared with the irradiation behaviors of other graphites. Dimensional shrinkage was observed in the whole irradiation temperature range, showing lower value than 2 %. The shrinkage rate showed the minimum in the irradiation temperature of around 850 deg C, followed by the increase for the samples irradiated at higher temperatures. The dimensional stability of the material was clarified to be almost the same with that of H451 graphite. The CTE, thermal resistivity and Young's modulus increased in the early stage of irradiation and then only the CTE decreased while the thermal resistivity and Young's modulus levelled off with further irradiation. The neutron fluence showing the maximum CTE shifted to the

lower fluence with increasing irradiation temperature. The increases of both thermal resistivity and Young's modulus were remarkable for the samples irradiated at lower temperatures. Compressive and bending strengths measured at room temperature increased after irradiation as well. The corrosion rate with water-vapor of 0.65 % in helium at high temperatures decreased owing to irradiation and the reduction was independent of irradiation temperature and neutron fluence. The activation energy for the reaction was estimated to be the same before and after irradiation.

1260 (JAERI-M—86-192, pp 144-157) **Degradations of thermal shock resistance and the fracture toughness of reactor graphite subjected to neutron irradiation.** Sato, S.; Kawamata, K.; Kurumada, A.; Ugachi, H.; Awaji, H. (Ibaraki Univ., Hitachi, Japan. Faculty of Engineering). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

This paper deals with the irradiation effects on the thermal shock resistance Δ = σ/sub t/ k/E/sub a/ (σ/sub t/: tensile strength, k: thermal conductivity, E: Young's modulus, a: thermal expansivity) and the thermal shock fracture toughness nabla = K/sub Ic/ k/E/sub a/ (K/sub Ic/: fracture toughness value of mode 1) in addition to other mechanical properties such as the diametral compressive strength and fracture toughness. Two kinds of near isotropic graphite subjected to neutron irradiations of (1.1 - 1.5) x 10/sup 21/ n/cm/sup 2/ (> 29 fJ) at 750 - 1000 deg C are prepared for the measurements. One is an isostatically molded graphite IG-11 with fine grain petroleum coke. The other is a binderless molded graphite HCB-18 which was prepared using mesophase pitch carbon of very fine grain size. These measurements are carried out by means of our developed disk testing method. Results show that both the thermal shock resistance and the thermal shock fracture toughness of the two graphites after irradiation are found to decrease considerably in contrast with increasing trends of the usual mechanical strengths.

1261 (JAERI-M—86-192, pp 158-162) **Application of ISRM testing methods to fracture toughness testing of graphite.** Hashida, T.; Fukasawa, T.; Takahashi, H.; Ishiyama, S.; Oku, T. (Tohoku Univ., Sendai, Japan). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

Fracture toughness measurements of nuclear grade graphites, IG11 and PGX, were made by means of AE technique. Tests were conducted on edge-notched round bend bar, edge-notched short bar and round compact tension specimens. These round-shaped specimens used in this study have been proposed for standard fracture toughness tests of rock as a draft of testing standard of International Society for Rock Mechanics (ISRM). Taking the observed nonlinear deformation behavior into account, J-integral approach was utilized to determine the fracture toughness of the graphites. It is shown that the critical J integral determined by AE technique, J/sub iAE/, is independent of specimen geometry. Based on this experimental results, the fracture toughness K/sub IC/ of the graphites was determined from the J/sub iAE/ values. K/sub IC/ value of IG11 was 1.04 MPa√m, and 0.77 MPa√m for PGX respectively. Furthermore, the specimen size effect of the fracture toughness determined by the J-integral/AE method is discussed.

1262 (JAERI-M—86-192, pp 227-232) **Acoustic emission from polycrystalline graphites.** Ioka, I.; Yoda, S.; Oku, T.; Miyamoto, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

Acoustic emission was monitored from polycrystalline graphites with different microstructure (pore size and pore volume) subjected to compressive loading. The graphites used in this study comprised five brands, that is, PGX, ISEM-1, IG-11, IG-15, and ISO-88. A root mean square (RMS) voltage and event counts of acoustic emission for graphites were measured during compressive loading. The acoustic emission was measured using a computed-based data acquisition and analysis system. The graphites were first deformed up to 80 % of the average fracture stress, then unloaded and reloaded again until the fracture occurred. During the first loading, the change in RMS voltage for acoustic emission was detected from the initial stage. During the unloading, the RMS voltage became zero level as soon as the applied stress was released and then gradually rose to a peak and declined. The behavior indicated that the reversed plastic deformation occured in graphites. During the second loading, the RMS voltage gently increased until the applied stress exceeded the maximum stress of the first loading; there is no Kaiser effect in the graphites. A bicrystal model could give a reasonable explanation of this results. The empirical equation between the ratio of σ/sub AE/ to σ/sub f/ and σ/sub f/ was obtained. It is considered that the detection of microfracture by the acoustic emission technique is effective in macrofracture prediction of polycrystalline graphites.

1263 (JAERI-M—86-192, pp 213-216) **Irradiation dimensional stability of graphite containing green coke filler.** Kalyagina, I.P.; Virgiliev, Yu.S. Jan 1987. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW. (IWGGCR—11; CONF-8609133—Summ.).

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

The graphite based on green petroleum coke belongs to the strongest carbons prepared according to the conventional electrode technology. The use of this coke favors the development of a monolithic structure having no strict boundary between the cone filler grains and the coked binder, which affects the dimensional stability of the articles made of such graphite. The dimensional stability under irradiation of fine grained graphite and coarse grained graphite based on green petroleum coke as well as that of reactor graphite were investigated. The comparison of the properties of reactor graphite and coarse grained graphite showed that the use of such technology enabled to obtain the materials of a similar crystalline structure perfection as seen from the close values of graphitizability, lattice parameters and the dimensions of coherent scattering areas. The main distinction between them was in the indices of anisotropy and density. The coarse grained graphite has the much lower level of porosity and higher density. According to the irradiation experiment, the relative dimensional change of fine and coarse grained graphites based on green coke was larger than that of reactor graphite at low irradiation temperature. In the irradiation at 720 K, the shrinkage of reactor graphite was large. (Kako, I.).

1264 **(JAERI-M—86-192) Summary report of the IAEA specialists' meeting on graphite component structural design.** Sanokawa, Konomo (ed.). (Japan Atomic Energy Research Inst., Tokyo). Jan 1987. vp. (IWGGCR—11; CONF-8609133—Summ.). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780006/JAW.

From IAEA specialists' meeting on graphite component structural design; Tokai, Japan (8 Sep 1986).

Individual papers in scope for the data base are processed separately. (DLC)

1265 **(LA-UR—87-3019) Advances in inherently conducting polymers.** Aldissi, M. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 20p. (CONF-8709138—1). NTIS, PC A02. Order Number DE88000501/JAW.

From 1. European polymer symposium; Lyon, France (14 Sep 1987).

The discovery of polyacetylene as the prototype material led to extensive research on its synythesis and characterization. The techniques that emerged as the most important and promising ones are those that dealt with molecular orientation and that resulted in conductivities almost as high as that of copper. The study of dozens of other materials followed. Interest in conducting polymers stems from their nonclassical optical and electronic properties as well as their potential technological applications. However, some of the factors currently limiting their use are the lack of long-term sta-

bility and the need to develop conventional low-cost techniques for easy processing. Therefore, research was extended toward solving these problems, and progress has been recently made in that direction. The synthesis of new materials such as stable and easily processable alkylthiophenes, water-soluble polymers, and multicomponent systems, including copolymers and composites, constitutes an important step forward in the area of synthetic metals. However, a full understanding of materials chemistry and properties requires more work in the years to come. Although, few small-scale applications have proven to be successful, long-term stability and applicability tests are needed before their commercial use becomes reality.

1266 **(LA-UR—87-3027) Molecular and supramolecular orientation in conducting polymers.** Aldissi, M. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 13p. (CONF-8708139—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000533/JAW.

From International symposium on polymers for advanced technologies; Jerusalem, Israel (16 Aug 1987).

Intrinsic anisotropy in electrical and optical properties of conducting polymers constitutes a unique aspect that derives π-electron delocalization along the polymer backbone and from the weak inter-chain interaction. To acquire such an intrinsic property, conducting polymers have to be oriented macroscopically and microscopically (at the chain level). A review of the various techniques, including stretch-alignment of the polymer and of precursor polymers, polymerization in ordered media, i.e., in a liquid crystal solvent, and synthesis of liquid crystalline conducting polymers will be given. 29 refs.

1267 **(LA-UR—87-3048) Conducting hybrid polymeric systems.** Aldissi, M.; White, J.W.; Agnew, S.; Jorgensen, B.S. (Los Alamos National Lab., NM (USA); Australian National Univ., Canberra). Sep 1987. Contract W-7405-ENG-36. 10p. (CONF-8709138—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000527/JAW.

From 1. European polymer symposium; Lyon, France (14 Sep 1987).

The studies took advantage of the opportunities offered by copolymerization for gaining insight into electrical conduction, morphology, phase separation, polymer-polymer interfaces, and solubility. Copolymerization is technologically important for it allows one to tailor-make products with specifically desired properties. However, the utility of copolymerization involving conjugated, rigid components could be different from that of conventional polymers. This paper is focused on the synthesis and properties of various materials: Rod-coil systems such as polyisoprene/polyacetylene diblock copolymers (resonance raman and small angle neutron scattering studies correlated to conductivity); and alternating copolymers such as poly (arylpyrroles) (electrochemical synthesis and characterization). 8 refs., 4 figs.

1268 **(LBL—22903) Evaluation of the Mellen "EDG" furnace for growth of large diameter GaAs single crystals in a horizontal configuration.** Bourret, E.D.; Guitron, J.B.; Haller, E.E. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 17p. (CONF-870799—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000463/JAW.

From American conference on crystal growth; Monterey, CA, USA (13 Jul 1987).

An extensive evaluation of the Mellen "EDG" furnace has been conducted in order to assess its performance for growth of large diameter (2 and 3 in.) GaAs crystals in the horizontal configuration. The axial and radial temperature gradients were found to influence strongly the crystal-melt interface shape and crystalline perfection of the crystals. When the axial thermal gradients are small relative to the radial thermal gradients, the shape of the crystal-melt interface fluctuates in time as growth proceeds, indicating the presence of oscillatory convective flows in the melt. The crystal-melt interface becomes stable as the axial component of the thermal gradient over the solid is increased. The crystals produced with optimized gradient conditions have a low and uniform dislocation density. 11 refs., 6 figs., 2 tabs.

1269 **(LBL—23244) Far infrared Fourier transform spectroscopy of semiconductors.** Haller, E.E. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 34p. (CONF-870809—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000188/JAW.

From 6. international conference on fourier transform spectroscopy; Vienna, Austria (24 Aug 1987).

Fourier transform spectroscopy (FTS) is one of the most important tools in the study of shallow level donors and acceptors in semiconductors. When combined with a two-step photothermal ionization process detected photoconductively, FTS allows measurement of optical transitions of donor-bound electrons (and acceptor-bound holes) in ultra-pure germanium samples with impurity concentrations $<10^9$ cm^{-3} (i.e., one electrically active impurity in 4 x 10^{13} host atoms). The experimental high resolution study of the hydrogen-like excited state series of shallow levels has yielded as many as 19 lines of width as small as 10 μeV for some centers. These results have stimulated theoretical work which has led to the unambiguous assignment of quantum states to many bound excited states. Extensive studies of ultra-pure Ge crystals grown under different well-controlled conditions have led to the discovery of a large number of novel shallow impurity complexes. Study of the multiplicities and symmetries of the associated electronic states has led to a detailed understanding of the unusual static and dynamic structures of these novel centers. The chemical composition has been deduced from correlations between the concentration of a particular center and the materials involved in crystal growth. Isotopic substitution of hydrogen with deuterium has led to the unambiguous proof of the presence of hydrogen in several of the novel centers. In addition to the high resolution spectra of shallow electronic levels, vibrational spectra of bond-centered interstitial oxygen in ultra-pure Ge are noteworthy for their extraordinarily sharp lines. 48 refs., 12 figs.

1270 **(LBL—23742) Raman scattering spectrum along a bevel etched GaAs on Si, TEM [transmission electron microscope] study and GaAs p-i-n photodetector on Si.** Lo, Y.H.; Charasse, M.N.; Lee, H.; Vakhshoori, D.; Huang, Y.; Yu, P.; Liliental-Weber, Z.; Werner, M.; Wang, S. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA)). May 1987. Contract AC03-76SF00098. 8p. (CONF-870438—37). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000210/JAW.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Raman scattering is measured along a bevel-etched GaAs epitaxial film grown on Si by molecular beam epitaxial (MBE). From the correlation length profile of Raman scattering, most dislocation lines are confined in the 2000 A regions close to the interface. The strain profile calculated from the Raman peak shift shows that about 0.6% compressive strain exists near the interface because of lattice mismatch. However, as one moves away from the interface, the compressive strain is gradually counterbalanced by thermal expansion. Transmission electron microscope (TEM) studies of the local dislocation image and properties show that an ultra clean Si surface is essential for dislocation confinement. From high resolution TEM, we find that the distance between dislocations at the interface is nonuniform, varying from 50 A to 125 A with an average distance at 81 A. Finally, a GaAs p-i-n photodetector on Si substrate is fabricated. Even though a normal photoresponse curve is obtained, the high dark current (50/sub n/ A) and relatively low responsivity (0.01A/W) show that the material quality needs to be further improved to make a minority carrier vertical transition device. 10 refs., 8 figs.

1271 **(N—87-26155) Space environmental effects on graphite-epoxy compressive properties and epoxy tensile properties.** Fox, D.J.; Sykes, G.F. Jr.; Herakovich, C.T. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jul 1987. 177p. (NASA-TM—89297; NAS—1.15:89297; CCMS—87-11; VPI-E—87-13). NTIS, PC A09/MF A01.

This study characterizes the effects of electron radiation and temperature on a graphite-epoxy composite material. Compressive properties of the T300/934 material system were obtained at -250 F (-157 C), room temperature, and 250 F (121 C). Tensile specimens

of the Fiberite 934 epoxy resin were fabricated and tested at room temperature and 250 F (121 C). Testing was conducted in the baseline (nonirradiated) and irradiated conditions. The radiation exposure was designed to simulate 30 year, worst-case exposure in geosynchronous Earth orbit. Mechanical properties tended to degrade at elevated temperature and improve at cryogenic temperature. Irradiation generally degraded properties at all temperatures.

1272 **(N—87-26232) Synthesis, physical and chemical properties, and potential applications of graphite fluoride fibers.** Hung, C.C.; Long, M.; Stahl, M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1987. 15p. (CONF-8708163—1; NASA-TM—100156; E—3699; NAS—1.15:100156). NTIS, PC A02/MF A01.

From Conference on emerging technologies in materials; Minneapolis, MN, USA (18 Aug 1987).

Graphite fluoride fibers can be produced by fluorinating pristine or intercalated graphite fibers. The higher the degree of graphitization of the fibers, the higher the temperature needed to reach the same degree of fluorination. Pitched based fibers were fluorinated to flourine-to-carbon atom rations between 0 and 1. The graphite fluoride fibers with a fluorine-to-carbon atom ration near 1 have extensive visible structural damage. On the other hand, fluorination of fibers pretreated with bromine or fluorine and bromine result in fibers with a fluorine-to-carbon atom ratio nearly equal to 0.5 with no visible structural damage. The electrical resistivity of the fibers is dependent upon the fluorine to carbon atom ratio and ranged from .01 to 10 to the 11th ohm/cm. The thermal conductivity of these fibers ranged from 5 to 73 W/m-k, which is much larger than the thermal conductivity of glass, which is the regular filler in epoxy composites. If graphite fluoride fibers are used as a filler in epoxy or PTFE, the resulting composite may be a high thermal conductivity material with an electrical resistivity in either the insulator or semiconductor range. The electrically insulating product may provide heat transfer with lower temperature gradients than many current electrical insulators. Potential applications are presented.

1273 **(ORNL/Sub—83-43369/01) Development of advanced fiber reinforced ceramics: Final report.** Starr, T.L.; Harris, J.N. (Georgia Inst. of Tech., Atlanta (USA). Research Inst.). 1987. Contract AC05-84OR21400. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000779/JAW.

A fundamental problem in the processing of ceramic composites is the fact that the incorporated fibers tend to reinforce the "green" structure, preventing the volume reduction and densification that usually is obtained during free sintering. Hot pressing is one approach to overcoming this problem, providing the necessary densification by application of pressure. An alternative approach is to maximize the green density of composite preforms and to utilize volume filling techniques to achieve high density. This type of process is more suitable for fabrication of large and complex shapes. Development of such processing is the primary thrust of this research program. The results of this program are organized into four topics. A review of models for the physical properties of composites is given. New understanding of cast and sinter processing of fiber/powder blends was gained and used to produce consistent, dense composites. These results are broadly applicable to many composite systems. Development work on silica and silicon nitride matrix composites is reported. The silica composites were fabricated using a precursor resin infiltration process to increase the sintered density. Silicon nitride composites were processed using reaction sintering of silicon powder/fiber preforms. In both cases, composites were produced with densities comparable to monolithic materials and using fabrication techniques suitable for large, complex components. This emphasis on "scale-able" processing is an important theme running throughout this work. 17 refs., 46 figs., 14 tabs.

1274 **(PNL—6264) Develop techniques for ion implantation of PLZT [lead-lanthanum-zirconate-titanate] for adaptive optics.** Batishko, C.R.; Brimhall, J.L.; Pawlewicz, W.T.; Stahl, K.A.; Toburen, L.H. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000642/JAW.

Research was conducted at Pacific Northwest Laboratory to develop high photosensitivity adaptive optical elements utilizing ion implanted lanthanum-doped lead-zirconate-titanate (PLZT). One centimeter square samples were prepared by implanting ferroelectric and anti-ferroelectric PLZT with a variety of species or combinations of species. These included Ne, O, Ni, Ne/Cr, Ne/Al, Ne/Ni, Ne/O, and Ni/O, at a variety of energies and fluences. An indium-tin oxide (ITO) electrode coating was designed to give a balance of high conductivity and optical transmission at near uv to near ir wavelengths. Samples were characterized for photosensitivity; implanted layer thickness, index of refraction, and density; electrode (ITO) conductivity; and in some cases, residual stress curvature. Thin film anti-ferroelectric PLZT was deposited in a preliminary experiment. The structure was amorphous with x-ray diffraction showing the beginnings of a structure at substrate temperatures of approximately 550°C. This report summarizes the research and provides a sampling of the data taken during the report period.

1275 **(SAND—87-1239C) MBE groth of InAsSb strained-layer superlattices.** Dawson, L.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-8709133—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000365/JAW.

From 14. international symposium on gallium arsenide and related compounds; Crete, Greece (28 Sep 1987).

The use of tensile strain parallel to [100] interfaces in InAs/sub x/Sb/sub 1-x/ strained-layer superlattices (SLSs) has been used to reduce the energy gap below that of unstrained alloys. Dislocation-free SLSs with $x = .10$ have been prepared. Cracking in structures with $x > .10$ has been overcome by the initial growth of a severely mismatched InAs/sub.35/Sb/sub .65/ buffer layer, followed by compressively strained InAs/sub .27/Sb/sub .73/ and InAs/sub .20/Sb/sub .80/ buffer layers. SLSs with $x = .20$ show substantial dislocation filtering and significant optical absorption at wavelengths beyond that of equivalent bulk alloys. 6 refs., 5 figs.

1276 **(SAND—87-1396C) Parachute materials.** Peterson, C.W.; Johnson, D.W. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 72p. (CONF-8706165—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014845/JAW.

From Parachute systems technology: fundamentals, concepts, and applications; Munich, F.R. Germany (22 Jun 1987).

The purpose of this paper is to present guidelines for the use of Kevlar and nylon materials in modern parachute systems. Nylon has been used in parachutes for many years, so this discussion will place emphasis upon Kevlar material properties and their application to parachute design and construction. Kevlar-29 is an aramid fiber manufactured by DuPont and is being used on parachute systems requiring high strength-to-weight ratios or sustained strength at high temperatures. Tests of parachutes using Kevlar webbing, braided cords, ribbons, and thread have demonstrated that these Kevlar materials can be used successfully in ribbon parachutes with no detrimental effects on performance. A few changes must be made in the design of a ribbon parachute to accommodate Kevlar's high modulus. Examples of parachutes that use Kevlar suspension lines, radials, ribbons, reefing lines, bridles, and skirt bands are presented to show that they are much lighter and more resistant to aerodynamic heating than all-nylon parachutes. Nylon continues to be an important material for high-performance parachute systems, however. New nylon weaves have resulted in lighter weight, stronger ribbon materials with excellent sewability characteristics.

1277 **(UCRL—95577) Study of zero CTE [coefficients of thermal expansion] of graphite/epoxy composites.** Feng, W.W.; Schauer, D.A. (Lawrence Livermore National Lab., CA (USA)). 14 Oct 1986. Contract W-7405-ENG-48. 14p. (CONF-870189—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013557/JAW.

From Society of Mechanical Engineers composites in manufacturing 6 conference; Anaheim, CA, USA (19 Jan 1987).

The design of composite with very low coefficients of thermal expansion (CTE) is presented in this paper. The magnitude of the CTE of a composite laminate is usually coupled with the mechanical properties. In this paper, the thermomechanical properties of multidirectional laminates, consisting of plies with arbitrary ori-

entations and stacking sequences, are obtained by the laminate theory. Tests are performed to determine the thermomechanical properties of unidirectional composite laminates and to verify the analytical results for a variety of composite laminates. These tests measure the elastic moduli, Poisson's ratios, and CTEs. In order to provide the required accuracies for measuring low CTEs, a differential dilatometer is used. All test results agree with the analytical predictions. 6 figs.

1278 **Comment on "Interface charge polarity of a polar on nonpolar semiconductor GaAs/Si with Ga and As prelayers" [Appl. Phys. Lett. 49, 1257 (1986)].** Won, T.; Munns, G.; Houdre, R.; Morkoc, H. (Coordinated Science Laboratory, University of Illinois, 1101 West Springfield Ave, Urbana, Illinois 61801). *Applied Physics Letters;* **51**: No. 21, 1756-1756(23 Nov 1987).

In this comment we report new experimental results for the capacitance voltage measurement of p-GaAs/n-Si heterojunction diodes and point out the inappropiate assumption used in our previous letter that the boundaries of the depletion layer do not change much despite the presence of the prelayer. (AIP)

1279 **Determination of the natural valence-band offset in the In/sub x/Ga/sub 1-//sub x/As system.** Hwang, J.; Pianetta, P.; Shih, C.K.; Spicer, W.E.; Pao, Y.; Harris J.S. Jr. (Stanford Synchrotron Radiation Laboratory, Stanford University, Stanford, California 94305). *Applied Physics Letters;* **51**: No. 20, 1632-1633(16 Nov 1987).

The natural valence-band offset (NVBO) between semiconductors in a common anion alloy system can be determined through photoemission core level measurements. In this work, we tested this method in the In/sub x/Ga/sub 1-//sub x/As system. The NVBO between GaAs and InAs is measured to be 0.11 +- 0.05 eV. This result is in approximate agreement with the experimental value of 0.17 +- 0.07 eV determined by x-ray photoemission spectroscopy measurements.

1280 **Time-of-flight x-ray photoconductivity of HgI_2.** Kurtz, S.R.; Hughes, R.C.; Ortale, C.; Schnepple, W.F. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **62**: No. 10, 4308-4310(15 Nov 1987). Contract AC04-76DP00789.

Time-of-flight photoconductivity measurements were performed on HgI_2 using a penetrating, pulsed x-ray source, simulating the operation of photoconductive x-ray detectors. By examining a variety of HgI_2 samples, a wide range of electron and hole mobilities were observed, but in all cases hole transport was highly localized, limiting the collection of the photocarriers in HgI_2 detectors. The intrinsic photocarrier generation and recombination processes differed from classical Onsager and Langevin mechanisms observed in low-mobility photoconductors.

1281 **Reentrant nematic and multiple smectic-A liquid crystals: Intrachain flexibility constraints.** Dowell, F. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **36**: No. 10, 5046-5058(15 Nov 1987). Contract W-7405-ENG-36.

A recent new microscopic, molecular statistical-physics theory for the intrachain constraints on the n-alkyl tail-chain flexibility for molecules composed of rigid rodlike cores and n-alkyl tail chains in the smectic-A_1, smectic-A/sub d/, and nematic (including reentrant nematic) liquid-crystal phases and the isotropic liquid phase is used to calculate relative stabilities as well as various thermodynamic and molecular ordering properties (including odd-even effects) for these phases. The molecules can interact via these site-site intermolecular interactions: hard (steric) repulsions, various Lennard-Jones (LJ) potentials for soft repulsions and London dispersion attractions, and/or dipolar forces (dipole-dipole and dipole—induced-dipole). The theoretical results in this paper are in significantly better agreement with experiment than are results in earlier papers using older, more approximate theories. The effects of varying pressure, tail-chain flexibility, and intermolecular interactions on the relative stabilities of the multiple smectic-A phases and the reentrant nematic phase are presented. These relative phase stabilities are sensitive to subtle changes in these variables. Predictions and accompanying physical explanations are also made for various systems that have not yet been chemically synthesized and/or studied experimentally.

1282 **Optical bleaching in an epitaxial (Al,Ga)As Fabry—Perot resonator.** Gourley, P.L.; Drummond, T.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **51**: No. 18, 1395-1397(2 Nov 1987). Contract AC04-76DP00789.

We report studies of bleaching action in an epitaxial Fabry—Perot resonator grown by molecular beam epitaxy. These new structures hold exciting potential for surface-emitting lasers, optical switches, and optical modulators. The structure consisted of a multiple quantum well of AlGaAs and GaAs surrounded by two quarter-wave high reflectors with alternating layers of AlAs and AlGaAs. The spectral and temporal transmittances under intense optical pulses are reported here. The spectral data provide simultaneous information on nonlinear changes in both real and imaginary parts of the refractive index. The temporal data show that the transmittance can be switched up to three orders of magnitude in less than the experimental resolution of 300 ps, and provide evidence for time compression of optical pulses.

1283 **Optical glass fabrication technology. 1: Fine grinding mechanism using bound diamond abrasives.** Edwards, D.F.; Hed, P.P. (Lawrence Livermore National Laboratory, Materials Fabrication Division, P.O. Box 808, Livermore, California 94550). *Applied Optics;* **26**: No. 21, 4670-4676(1 Nov 1987). Contract W-7405-ENG-48.

The mechanism for fine grinding using diamond tools is shown to depend on the properties of glass, the acidity of the grinding fluid, as well as the chemical and mechanical properties of the abrasive bonding material. Knowledge of the mechanism is essential for the implementation of this technology for the deterministic fabrication of precision optical surfaces. We find that the fracture mechanism is preferred to plastic scratching for most applications.

1284 **Optical glass fabrication technology. 2: Relationship between surface roughness and subsurface damage.** Hed, P.P.; Edwards, D.F. (Lawrence Livermore National Laboratory, Materials Fabrication Division, P.O. Box 808, Livermore, California 94550). *Applied Optics;* **26**: No. 21, 4677-4680(1 Nov 1987). Contract W-7405-ENG-48.

For glass grinding conditions where fracture is the principal mechanism, a constancy is found between the depths of surface roughness and subsurface damage. For a range of experimental conditions we find the ratio of subsurface damage to surface roughness to be 6.2—6.4 for bound diamond abrasive grinding. This is larger than the value reported for loose abrasive grinding (3.7—4.0). The constancy of this value has great practical importance. From a measurement of the surface roughness one can obtain an accurate estimate of the damage layer thickness that must be eliminated by polishing or subsequent grinding operations.

1285 **Kinetics of surface area changes in glasslike carbon: reanalysis of the data.** Lachter, J.; Bragg, R.H. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, and Department of Materials Science and Mineral Engineering, Hearst Mining Building, University of California, Berkeley, California 94720). *Journal of Materials Research;* **2**: No. 6, 846-849(Nov 1987). Contract AC03-76SF00098.

Previous small-angle scattering measurements of the kinetics of changes of the surface area of pores in an annealed glasslike carbon have been reanalyzed in terms of the Lifschitz, Slyozov, and Wagner coarsening theory in which the surface area is used to obtain an average spherical pore size. When the data are corrected for the transient heat-up time to reach the annealing temperature, the reanalysis leads to an activation energy of 75 +- 7.2 kcal/mol, in agreement with recent results (75 +- 3.6 kcal/mol) obtained using direct measurements of changes in pore size as determined by the pore radius of gyration. The best value for the activation energy for vacancy migration in carbon is therefore estimated at 75 +- 3.2 kcal/mol.

1286 **Microstructural characterization of $YBa_2Cu_3O_{7-x}$.** Sarikaya, M.; Thiel, B.L.; Aksay, I.A.; Weber, W.J.; Frydrych, W.S. (Department of Materials Science and Engineering, and Advanced Materials Technology Program, Washington Technology Center, University of Washington, Seattle, Washington 98195). *Journal of Materials Research;* 2: No. 6, 736-742(Nov 1987).

A detailed characterization study on polycrystalline specimens of $YBa_2Cu_3O_{7-x}$ that were prepared by solid-state reaction techniques has been carried out. In the samples studied, magnetization and reaistivity measurements indicate superconductivity onset temperatures of up to 89 K. Transmission electron microscopy (TEM) techniques have been used to facilitate direct microstructural characterization. It is shown that the planar defects on (001) planes form during the ion milling of the samples and are not directly connected with superconductivity. Laser Raman spectroscopy has revealed that these materials are sensitive to environmental degradation.

1287 **Optical transmission of graphite and potassium graphite intercalation compounds.** Zhang, J.M.; Eklund, P.C. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). *Journal of Materials Research;* 2: No. 6, 858-863(Nov 1987).

The results of an optical transmission study through ~1000 A thick flakes of graphite and the potassium graphite intercalation compounds KC_8 and KC_{24} in the photon energy range of 1—5.5 eV are reported. Structure in the transmission spectra associated with the Drude minimum, the threshold for inter-π-band and the graphitic M-point absorption are observed. The transmission spectra are found to be consistent with the dielectric function $\epsilon(\omega)$ obtained from previous reflectance studies. The influence of the electronic absorption in the quasi-two-dimensional carbon π-bands on the general form of the transmission spectra of graphite intercalation compounds is also shown.

1288 **Sum-frequency vibrational spectroscopy of a Langmuir film: Study of molecular orientation of a two-dimensional system.** Guyot-Sionnest, P.; Hunt, J.H.; Shen, Y.R. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review Letters;* 59: No. 14, 1597-1600(5 Oct 1987).

Using infrared-visible sum-frequency generation as a probe, we have obtained the vibrational spectrum of a monolayer of pentadecanoic acid on a water surface in the CH stretch region. We have monitored the molecular orientation at different surface densities. It was found that the molecules in the liquid condensed phase have their alkane chains extended and oriented nearly normal to the surface, while in the liquid expanded phase the chains are highly disordered.

1289 **Hole-burning spectroscopy and relaxation dynamics of amorphous solids at low temperatures.** Jankowliak, R.; Small, G.J. (Dept. of Energy, Ames, IA). *Science (Washington, D.C.);* 237: 618-624(7 Aug 1987).

The magnitude and temperature dependence of most of the properties of amorphous solids are anomalous at very low temperatures (≦ 1 Kelvin). Phonon-assisted tunneling of a distribution of glassy bistable configurations, or two-level systems, can account for these anomalies. A unified understanding of the low-temperature properties is required for an understanding of the glassy state. Persistent nonphotochemical hole burning of impurity optical transitions allows a glass state to be produced that is thermally inaccessible to the preburn state, and that allows the probing of tunneling dynamics on time scales that range between picoseconds and days. These data combined with recently obtained distribution functions for the two-level systems offer new insights into the tunneling dynamics.

1290 **Effects of oxygen doping on copper Chevrel compounds.** Wright, W.H.; Holmgren, D.J.; Friedmann, T.A.; Maher, M.P.; Pazol, B.G.; Ginsberg, D.M. (Univ. of Illinois, Urbana). *Journal of Low Temperature Physics;* 68: No. 1-2, 109-123(Jul 1987).

The Chevrel compounds $Cu_{1.8}Mo_6S_{8-x}O_x$ have been studied, where x = 0.00, 0.05, and 0.10. In order to establish the effects of incorporating a small amount of oxygen into $Cu_{1.8}Mo_6S_8$, they have measured lattice parameters, superconducting transition temperature T/sub c/, and the temperature dependence of both the upper critical field H/sub c2/ and the magnetic susceptibility chi. They show that the usual method of making this compound incorporates oxygen, and that this impurity may be removed by gettering the material with Y_2S_3. They observe that the substitution of oxygen for sulfur in $Cu_{1.8}Mo_6S_8$ increases T/sub c/ and decrease the ratio c/a of the hexagonal lattice constants and chi. A breakdown in the rigid-band approximation is indicated by a comparison of the relative signs of the effect on T/sub c/ and that on chi. In addition to these observations, they report on a correlation between hardness and T/sub c/ of $Cu_{1.8}Mo_6S_8$ and on the temperature dependence of the magnetic susceptibility of $Cu_{3.2}Mo_6S_8$.

1291 **High-damage-fluence laser glass for Nova.** Wallerstein, E.P.; Campbell, J.H.; Grens, J.Z.; Greiner, G.J.; Hatcher, C.W.; Kimmons, J.F.; Marion, J.E.; Milam, D.; Pitts, J.H.; Walmer, D. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550). pp 38-40 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

The ten-beam Nova laser at the Lawrence Livermore National Laboratory is the world's largest and most powerful laser system. LLNL has worked with two Nova glass vendors, Hoya Optics, Inc., and Schott Glass Technologies, Inc., to eliminate the Pt problem. Some details of the glass manufacturing process used by these companies are proprietary; thus much of the improved technology can only be discussed in general terms. The current state of the art for manufacturing large glass laser disks requires that the final fining and homogenizing be carried out in Pt crucibles; therefore, it has been necessary to find ways to prevent the formation of Pt particles in the glass in the presence of Pt used in the melting process. Using oxidizing conditions combined with newly developed melting techniques, the metallic Pt contamination in phosphate laser glass has been reduced by a factor of —8000 to an average of —1/2 particle per disk. A related problem is the detection of Pt particles at an early stage of manufacture. It is nearly impossible to inspect visually large volumes of laser glass and insure that there are no microscopic Pt particles. Therefore, the authors developed an automated laser scanning system to test for the presence of damaging inclusions. The system uses a YAG laser to deliver high-fluence pulses to the glass disk. The pulse fluence is — 2-3 times the Pt damage threshold. When present, Pt inclusions are easily detected by the characteristic fracture sites they create. The laser operates at 20 HZ and is used to scan the entire disk in —4-8 h. Postshot examination of the disk for damage sites takes —1 h. If the glass does not meet the Nova specification it is rejected. LLNL has provided damage test systems to both Hoya and Schott which are being used to test all the production glass.

1292 **Light-induced defect generation and thermal healing in amorphous silicon-germanium alloys.** Aljishi, S.; Smith, Z.E.; Chu, V.; Kolodzey, J.; Slobodin, D.; Conde, J.P.; Shen, D.S.; Wagner, S. (Princeton Univ., NJ). pp 25-32 of Stability of amorphous silicon alloy materials and devices. Stafford, B.L.; Sabisky, E. (eds.). New York, NY; American Institute of Physics (1987). (CONF-870116—). Contract AC02-76CH03073.

From International conference on stability of amorphous silicon alloy materials and devices; Palo Alto, CA, USA (28 Jan 1987).

The electronic and optical properties of a-Si,Ge:H,F alloys are investigated for the initial (as-grown) state as well as after annealing, light soaking, and subsequent annealing. The optical absorption spectra were determined from optical transmission, the constant photocurrent technique and photothermal deflection spectroscopy. The photoconductivity and the temperature dependence of the dark conductivity were measured. A post-deposition anneal was found to improve the measured properties for some of the alloys. The properties of the high gap, $E_{opt} > 1.4$ eV, and the low gap, $E_{opt} < 1.4$ eV, alloys change differently with light soaking. For the high gap alloys, there is an increase in the

subgap absorption, a decrease in the photoconductivity and the dark conductivity and an increase in the activation energy with light exposure. The gap alloys show increasing subgap absorption with light soaking, however, the photoconductivity remains constant and the dark conductivity increases and its activation energy decreases.

1293 **Apparatus for coating and impregnating filament with resin.** Robinson, S.C.; Pollard, R.E. (to Dept. of Energy). US Patent Application 6-942,741. 17 Dec 1986. 8p. Contract AC05-84OR21400. DE88000853 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000853/JAW.

The present invention is directed to an apparatus for evenly coating and impregnating a filament with binder material. Dimension control and repeatability of the coating and impregnating characteristics are obtained with the apparatus.

1294 **Fabrication of precision glass shells by joining glass rods.** Gac, F.D.; Blake, R.D.; Day, D.E.; Haggerty, J.S. (to Dept. of Energy). US Patent Application 6-942,148. 16 Dec 1986. 15p. Contract W-7405-ENG-36. DE88000851 NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000851/JAW.

A method for making uniform spheres. The present invention allows uniform spheres to be made by first making a void in a body of material. The material is heated so that the viscosity is sufficiently low so that the surface tension will transform the void into a bubble. The bubble is allowed to rise in the body until it is spherical. The excess material is removed from around the void to form a sphere with a uniform inside diameter.

1295 **Some applications of cold crucible technology for silicon photovoltaic material preparation.** Ciszek, T.F. (Solar Energy Research Institute, Golden, CO 80401). pp 335-346 of Materials and new processing technologies for photovoltaics. Kapur, V.K.; Dismukes, J.P.; Pizzini, S. Pennington, NJ; The Electrochemical Society (1985). (CONF-841058—).

From Fall meeting of the Electrochemical Society; New Orleans, LA, USA (7 Oct 1984).

Cold crucible melt confinement was used for four different silicon crystallization methods of interest in photovoltaic material preparation-- directional solidification, Czochralski pulling, sheet growth, and continuous ingot casting. Large-grained, multicrystalline ingots were directionally solidified in cold crucibles, and grain sizes up to 5 mm were observed. Dislocation-free crystals were pulled in [111] and [100] orientations, using semiconductor-grade silicon. The edge-supporting pulling (ESP) growth method was employed for sheet growth. The sheets were solidified between quartz filaments. Continuous castings of square cross-section ingots with gain sizes of up to several millimeters was carried out. Material suitable for fabrication into solar cells was obtained by these methods. AM1 solar cells IV characteristics are presented for the different materials and for coprocessed for the different materials and for coprocessed cells made from conventional Czochralski crystals grown using quartz crucibles. Some purity and electrical property data for cold crucible crystals are also given.

1296 **Defects in amorphous silicon based alloys.** Von Roedern, B.; Mahan, A.H.; Williamson, D.L.; Madan, A. (Solar Energy Research Institute, Golden, CO 80401). pp 30-42 of Materials and new processing technologies for photovoltaics. Kapur, V.K.; Dismukes, J.P.; Pizzini, S. Pennington, NJ; The Electrochemical Society (1985). (CONF-841058—).

From Fall meeting of the Electrochemical Society; New Orleans, LA, USA (7 Oct 1984).

The authors report on amorphous hydrogenated binary alloy materials with bandgaps different from a-Si:H type alloys for their use in thin film cascade solar cells. In particular the authors studied a-SiC:H and a-SiSn:H materials and found that they exhibit larger densities of localized states and poorer electronic properties than a-SiC:H. Optimum alloys are prepared under deposition conditions different from those used for the best a-Si:H material. In the case of a-SiC:H, 3-fold coordinated (graphitic) C-bonding in the alloy was identified as the primary cause for the degradation.

1297 **Chemistry and kinetics for the passivation of polysilicon grain boundaries with monatomic hydrogen.** Ginley, D.S.; Haaland, D.M.; Hellmer, R.P. (Sandia National Labs., Albuquerque, NM 87185). pp 227-238 of Materials and new processing technologies for photovoltaics. Kapur, V.K.; Dismukes, J.P.; Pizzini, S. Pennington, NJ; The Electrochemical Society (1985). (CONF-841058—).

From Fall meeting of the Electrochemical Society; New Orleans, LA, USA (7 Oct 1984).

Monoatomic hydrogen has been used to passivate the grain boundaries of polycrystalline silicon. The kinetics of passivation have been evaluated by measuring the electrical conductance as a function of sample thickness and extent of hydrogen plasma treatment. It has been found that either one- or two-dimensional Fickian diffusion models can give excellent fits to the depth of hydrogen penetration versus time data. The one-dimensional model is computationally simple and gives effective diffusion coefficients which can be used for process optimization. Fourier transform infrared (FT-IR) has been used to identify where hydrogen is located in the silicon and how it is bonded. The results, coupled with sample etching and conductivity measurements, have yielded information about the relation of each type of bonded hydrogen to sample conductivity. No direct correlation has been observed between conductivity and any single type of bonded hydrogen for samples annealed at 400 and 600 C.

40 CHEMISTRY

REFER ALSO TO CITATION(S) 1161

1298 **(BNL-NCS—39950) The atomic weight and isotopic composition of oxygen and their variation in nature.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 18p. (CONF-8708105—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014397/JAW.

From 34. IUPAC General Assembly; Boston, MA, USA (21 Aug 1987).

There is a problem with the absolute abundance measurements of oxygen. One of these calibrated measurements is in error, either oxygen in air, or oxygen in (V-SMOW), Vienna's standard mean ocean water reference material. Nier's measurement in air is probably wrong by three times his quoted error and his ratio for $^{18}O/^{16}O$ should be 0.002053 and not 0.002044. Fortunately, this has only a minor effect on the atomic weight. However, this error raises doubts on all $^{17}O)/^{16}O$ values. Each $^{17}O/^{16}O$ is determined using an enrichment factor, relative to the value of $^{17}O/^{16}O$ in the standard, which is the square root of the enrichment factor for $^{18}O/^{16}O$ relative to the standard. All standards, including V-SMOW, have $^{17}O/^{16}O$ values which have been derived originally from Nier's measurement of oxygen in air. In addition, a review of the literature provides isotopic abundance variations in various sources of oxygen. 115 refs., 12 tabs.

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 64, 204, 412, 413, 421, 532, 1376, 1377, 1379, 1678, 1683, 1692, 1751, 1808, 1814, 1836, 1944, 1945, 1946, 1947, 1948, 1950, 1951, 1952, 1953, 1953, 1954, 1955, 1957, 1958

1299 **(AAEC/E—644) Evaluation of neutron activation analysis for the measurement of isotopic abundances in molybdenum-98 enriched molybdenum.** Hetherington, E.L.R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700088/JAW.

Molybdenum enriched to approximately 50 per cent /sup 98/Mo is required for the development of a portable /sup 99m/Tc generator based on the zirconium molybdate gel system developed by the AAEC. It has been proposed that existing AAEC facilities be used to enrich molybdenum, and neutron activation analysis has been evaluated as a means of monitoring the enrichment process. Simulated enriched targets of MoO/sub 3/ with /sup 98/Mo abun-

dances ranging from 30 to 90 per cent were prepared by diluting 96.87 per cent enriched /sup 98/MoO/sub 3/ with the natural trioxide. These targets were each irradiated simultaneouly with a reference natural MoO/sub 3/ target in a thermal neutron flux of 7.5 x 10/sup 12/ neutrons cm/sup -2/s/sup -1/ where the reactions /sup 92/Mo(n,γ)/sup 93/Mo, /sup 98/Mo(n,γ)/sup 99/Mo and /sup 100/Mo(n,γ)/sup 101/Mo-/sup 101/Tc occur. The isotopic abundances of /sup 98/Mo and /sup 100/Mo were determined with an accuracy +- 2 percent by comparing the yields of /sup 99/Mo-/sup 99m/Tc and /sup 101/Mo-/sup 101/Tc, respectively, in the enriched and natural targets. The activation yield of /sup 93/Mo was too low for the determination of the /sup 92/Mo abundances.

1300 **(AERE-R—12456) Observations on the choice of the excitation source for the x-ray fluorescence determination of plutonium in solutions.** Taylor, B.L.; Metcalfe, B. (UKAEA Atomic Energy Research Establishment, Harwell. Instrumentation and Applied Physics Div.). Dec 1986. 13p. H.M. Stationery Office, London, price Pound 4.00.

The selection of the appropriate photon excitation source for a particular XRF determination depends on a number of factors. An important aid in making the choice is the use of a statistically based figure of merit. In the case of plutonium measurements in reprocessing plant solutions, special features of the passive background from the sample also have an important influence on the selection.

1301 **(AERE-R—12502) High resolution electron and ion microscopy.** Bellamy, B.A. (ed.). (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Jan 1987. 24p. (CONF-8611177—). H.M. Stationery Office, London, price Pound 4.00.

From UKAEA conference on materials analysis by physical techniques; Springfields, UK (11 Nov 1986).

Papers presented at the Conference cover the application of high resolution electron and ion microscopical techniques to the study of materials. Invited papers were presented on high resolution electron microscopy and scanning tunnelling microscopy. Papers were also presented on X-ray diffraction techniques, laser based techniques, autoradiography and atomic absorption spectrophotometry.

1302 **(CEA-CONF—8885) Preparation and calibration of a double internal standard for very precise uranium and plutonium mass spectrometric analysis.** Hagemann, R.; Cesario, J.; Lucas, M.; Retali, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Chimie Appliquee et d'Etudes Analytiques). Sep 1986. 8p. (CONF-860912—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752925/JAW.

From International conference on nuclear and radiochemistry; Beijing, China (1 Sep 1986).

Mass fractionation occurring during isotope ratio measurements using thermal ionization mass spectrometry comes from the fact that the evaporation rate is higher for the light isotopes than for the heavier isotope of the same element. Two methods using internal normalization are available. 1) The measured value of the invariant ratio of two isotopes present in the sample is compared to a fixed value which is accepted as reference value by the users; 2) One adds to the sample a spike obtained from the mixture of 2 isotopes (non present in principle in the sample before) the abundance ratio of which is known with accuracy. - A quadruple spike has been prepared, certified and tested for U and Pu determinations in irradiated nuclear fuels. - The use os such a spike allows precise correction of mass fractionation occurring during the analysis. - It is demonstrated that a gain of a factor 3 is obtained on the precision of U and Pu concentrations compared to the normal procedure.

1303 **(CONF-8709132—2) Organic secondary ion emission from substituted aromatic/concentrated sulfuric acid solutions.** Leibman, C.P.; Todd, P.J.; Mamantov, G. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Sep 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000339/JAW.

From 6. international conference on secondary ion mass spectrometry - SIMS VI; Versailles, France (13 Sep 1987).

It has been determined empirically that a particular matrix must meet three criteria for enhanced secondary ion emission from a particular analyte: the analyte must be soluble in the matrix, the analyte must be basic with respect to the matrix in the condensed phase, and the gas phase proton affinity of the analyte must be greater than that of the matrix. Concentrated sulfuric acid meets these criteria for many substituted aromatic compounds. We have been using concentrated sulfuric acid (98%) as a liquid matrix for the enhanced emission of a variety of substituted aromatic compounds. Intense molecular ions and protonated molecules characteristic of dissolved aromatics are observed for several aromatic compound classes including acids, aldehydes, ketones, nitriles, and nitrogen heterocycles.

1304 **(DOE/EH—0053-Vol.3) The environmental survey manual: Appendix D.** (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC. Office of Environmental Audit). Aug 1987. 733p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88000273/JAW.

The purpose of this manual is to provide guidance to the Survey and Sampling and Analysis teams that conduct the one-time Environmental Survey of the major US Department of Energy operating facilities. This appendix contains procedures for chemical analysis of organics, inorganics, and radioisotopes. (ACR)

1305 **(DOE/ER/13463—T1) Novel macrocyclic carriers for proton-coupled liquid membrane transport: Progress report, 1 December 1986-31 July 1987.** Lamb, J.D.; Christensen, J.J.; Izatt, R.M. Bradshaw, J.S. (Brigham Young Univ., Provo, UT (USA)). 31 Aug 1987. Contract FG02-86ER13463. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000636/JAW.

The objective of our research program is to elucidate the chemical principles which are responsible for the cation selectivity and permeability of liquid membranes containing macrocyclic carriers. A number of new carriers were synthesized, based on the inclusion of triazolo, pyridono, and sulfonamide groups in the principal macrocyclic ring. Many of these show interesting transport characteristics, especially with respect to Li^+, Ag^+, and Cs^+. Hydrophobic crown ethers were successfully incorporated into supported liquid membranes of the flat sheet and hollow fiber types. Hollow fiber transport demonstrated selectivities and permeabilities similar to those observed in the flat sheets.

1306 **(DP-MS—87-116) Automated interfacial tension device for the determination of Purex solvent quality.** Slaughter, A.R.; Frazier, W.L. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 36p. (CONF-871015—1-Vugraphs). NTIS, PC A03. Order Number DE88000792/JAW.

From 30. conference on analytical chemistry in energy technology; Knoxville, TN, USA (20 Oct 1987).

The Purex and HM Processes at the Savannah River Plant (SRP) employ tributyl phosphate in n-paraffin as an extraction solvent. The presence of undesirable radiolytic- and hydrolytic-degradation products alters the miscibility of the solvent with aqueous solutions. Consequently, the solvent quality may be judged by its miscibility with an appropriate aqueous reagent. In the past, solvent integrity has been judged at SRP by the disengaging ratio technique, where the solvent is mixed with an aqueous reagent and the separation of the two phases is timed. In principle, this method is a simple and accurate measure of the solvent/aqueous miscibility. However, in practice the endpoint of the phase separation was often judged differently by different operators. Thus, the method suffered from poor reproducibility. To provide a reliable measure of the solvent/aqueous miscibility, an automated device was developed to quantify the interfacial tension between the two phases. The interfacial tension device is constructed from common laboratory equipment and is simple to operate. It is specifically designed for remote operation within a radioactive containment environment. A description of the device and a comparison of solvent quality data obtained by interfacial tension and disengaging ratio measurements are presented.

1307 **(FMPC—2074) The gas chromatographic analysis of biodenitrification gases: Topical report.** Werdmann, J.F. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). Oct 1987. Contract AC05-86OR21600. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000446/JAW.

A procedure for determining the quantities of various gases of interest present above a BDN reactor was developed. By means of this procedure the presence of unexpected gases, methane and nitrous oxide, was observed. The gas chromatograph was integrated into an automatic sampling system which permitted unattended operation with periodic analysis. 2 refs., 8 figs.

1308 **(GSI—87-29-Prepr.) Fast radiochemical separations with an automated rapid chemistry apparatus.** Schaedel, M.; Bruechle, W.; Haefner, B. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). May 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753300/JAW.

The microcomputer controlled Automated Rapid Chemistry Apparatus, ARCA, is described together with the He(KCl) gas-jet and the target and recoil chamber as it was developed and used in experiments at the heavy ion accelerator UNILAC. This set-up allows in a fast and reproducible way to carry out automated high performance liquid chromatographic separations in a chemically inert apparatus. Its modular design makes a large variety of different types of radiochemical separations easily possible. As examples a group separation from our search for superheavy elements and a separation of the elements Md, No and Lr is discussed.

1309 (IAEA-RL—139, pp 99-109) **Assay of rare elements in gold tailings using Neutron Activation Analysis (NAA).** Osae, E.K.; Akoto-Bamford, S. (Ghana Atomic Energy Commission, Kwabenya. Dept. of Physics). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

Gold tailings from the Ashanti Goldfield Corporation at Obuasi have been analysed for their rare element content using the Neutron Activation Analysis technique. The analysis showed the presence of Sr, Ti, Kr, Au, Ag, Zr and V in trace quantities. The absolute method of quantitative analysis was used for the quantification of the radionuclides that were identified. 6 refs, 5 figs, 1 tab.

1310 (IAEA-RL—139, pp 155-165) **Analysis of ores by XRF method.** Holynska, B.; Lankosz, M.; Wegrzynek, D. (Institute of Physics and Nuclear Techniques, Krakow, Poland). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

An X-ray fluorescence method for the determination of metals in multimetallic ores has been developed. In order to eliminate the interelement effects, intensity correction equation and fundamental parameters method have been applied. The applicability of the correction methods have been discussed. 7 refs, 1 fig, 5 tabs.

1311 (IAEA-RL—139, pp 167-180) **Correction method for particle-size effect in XRF analysis of ore slurries.** Holynska, B.; Lankosz, M. (Institute of Physics and Nuclear Techniques, Krakow, Poland). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

A method of correction for particle-size effects in XRF analysis of ore slurry is proposed. The use of calculated heterogeneity factor for correcting the intensity of fluorescent X-rays of determined element was suggested. The possibility of using a value of weight fraction of particles smaller than 75 μm for determining the heterogeneity factors was studied. The method was tested experimentally with the use of samples simulating zinc-lead and copper ore slurries. 12 refs, 5 figs, 4 tabs.

1312 **(IEN-DIRMA—02/87) Recovery of americium-241 from smoke detectors and lightning-conductor.** Carvalho, M.S. de; Sampaio, E.A.L.; Alleluia, I.B. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1987. 6p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703683/JAW.

A optimization for a separation and purification method for americium 241 is presented. This element is largely used in smoke detectors and lightning conductor (E.G.).

1313 **(INIS-BR—708) Spectrophotometric determination of tungsten with salicylic acid.** Goncalves, Z.C. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). Oct 1976. 57p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703461/JAW.

The method comprises the complexation of tungsten with salicylic acid in concentrated sulphuric acid yielding a reddish color. The maximum absorbance of the complex lies within 410-420 nm, 420 nm being the chosen wavelenght. The final concentration of salicylic acid is 0,080 g/ml. The sensitivity is 0,13 μg W(%T)/sup -1/ ml/sup -1/. Titanium, vanadium, rhenium, niobium and molybdenum interferes and must be separated, titanium being the strongest interferent. The separation procedures, advantages of the process, stoichiometric relations and equilibrium constant are discussed.

1314 **(INIS-BR—709) Vibration-rotational overtones absorption of solid hydrogens using optoacoustic spectroscopy technique.** Vieira, M.M.F. (Sao Paulo Univ. (Brazil)). 1985. 111p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703462/JAW.

Vibrational-rotational overtones absorption solid hydrogens (H/sub 2/, D/sub 2/, HD) is studied using pulsed laser piezoeletric transducer (PULPIT) optoacoustic spectroscopy is studied. A general downward shift in energy from isolated molecular energies is observed. Studying normal-hydrogen it was observed that the phonon excitations associated with double-molecular transitions are predominantly transverse-optical phonons, whereas the excitations associated with single-molecular transitions are predominantly longitudinal - optical phonons. Multiplet structures were observed for certain double transitions in parahydrogen and orthodeuterium. The HD spectrum, besides presenting the sharp zero-phonon lines and the associated phonon side bands, like H/sub 2/ and D/sub 2/, showed also two different features. This observation was common to all the transitions involving pure rotational excitation in H/sub 2/ and D/sub 2/, which showed broad linewidths. This, together with some other facts (fluorescence lifetime *approx*10/sup 5/ sec; weak internal vibration and lattice coupling), led to the proposition of a mechanism for the fast nonradiative relaxation in solid hydrogens, implied from some observed experimental evidences. This relaxation, due to strong coupling, would happen in two steps: the internal vibration modes would relax to the rotational modes of the molecules, and then this rotational modes would relax to the lattice vibration modes.

1315 **(INIS-BR—826) Isotope and hydrogeochemical studies in waters from the Rio Verde basin - Bahia.** Tavares, G.A. (Bahia Univ., Salvador (Brazil)). 1983. 108p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703722/JAW.

In situ measurements of water level, temperature and pH in 8 wells of the limestone rocks of the Bambui and Caatinga Formation, in the Rio Verde basin, were taken in August, September, October, November and December 1979 and in April and October of 1980. Samples of precipitation and surface waters in the region and ground water of that wells were analyzed for the content of Ca/sup ++/, Mg/sup ++/, Na/sup +/, K/sup +/, SO/sub =4/ HCO/sup -//sub 3/, Cl/sup -/ and isotopic ratios D/H and /sup 18/O//sup 16/O. For the groundwater samples it was also determined the radiocarbon activity and isotopic ratio /sup 13/C//sup 12/C of the dissolved carbonates the parameters determined were used to analyze the factors that control the groundwaters in the region within the hydrological cycle as well as an eventual leak into the region of water from the nearly reservoir of Sobradinho.

No relation was found between the groundwaters an the Sobradinho reservoir. Their apparent carbon-14 ages range from 2300 to 13640 years. As all samples come from a small area this indicates a heterogenous and complex aquifer. The data of isotopic ratio D/H and /sup 18/O//sup 16/O and the righ carbon-14 ages of the ground water suggest neether direct recharge from precipitation or correlations between the waters of Rio Verde and the aquifer. The chemical data of the slightly saline groundwater with differences in the chemical ratios with respect to the surface samples suggests some dissolution in addition to evaporation as the mechanisms that control the salt content in the aquifer.

1316 **(INIS-BR—833) Studies about the assimilation of thorium by plants in Morro do Ferro (MG).** Dotto, R.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica). 1985. 130p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703729/JAW.

The following aspects of thorium mobilization and bioassimilation are studied: the determination of Th-232 concentrations in typical plants indigenous to the Morro do Ferro environment; the behaviour of different complexing agents, including humic acids, to assess their effectiveness in solubilizing Th-232 from soils and weathered ore; assessment of the importance of these complexing agents in the bioassimilation of Th-232. Leaching experiments with soil and weathered ore samples demonstrate that Th-232 release increases in the order: water < humic acid 10ppm < humic acid 100 ppm < NTA 100ppm, reflecting the expected enlargement in the stability of these complexes, if other factors do not interfere. Inactive plants transferred into radioactive soil or weathered ore and irrigated with complexing solutions, show Th-232 content in leaves generally higher than in plants irrigated with complexing solutions, show Th-232 content in leaves generally higher than in plants irrigated with pure water, indicating the importance of chelates on the bioavailability of this element. The results obtained for thorium in this study give support to present ideas about the behaviour of plutonium in natural environments.

1317 **(INPE—4070) Measurements of iridium and the meteoric impact hypothesis at cretaceous end .** Sircilli Neto, F. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Dec 1986. 117p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703765/JAW.

Both instrumental and radiochemical neutron activation analysis methods were developed for trace-element determination, such as iridium and gold, for application in cosmochemistry. The magnitude of the determined concentrations is in the range of parts per billion. In the instrumental method 1.5 grams of sample were submitted to irradiation by 10/sup 13/ thermal neutrons.cm/sup -2/.s/sup -1/ during 32 hours. The gamma spectrometry is carried out with 10 to 12 hours counting time after 40 days of decay. In the radiochemical analysis a method of radiochemical separation of noble metals based on tellurium coprecipitation is implanted for iridium and gold determinations. As an application of the instrumental neutron activation analysis, preliminary iridium concentrations are measured for the first time in sedimentary rocks collected in the Brazilian territory. These techniques for determinations of iridium will be useful to check the asteroid impact hypothesis, which is supposed to be the cause of the great Cretaceous/Tertiary mass extinction, using samples collected in the South Hemisphere.

1318 **(IPNO-DRE—86-21) Identification of oxidation states of ultra-trace elements by radiation detection.** Guillaumont, R.; Chevallier, P.; Adloff, J.P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752728/JAW.

The determination of the oxidation state of ultra-trace elements in the environment, especially in the case of actinides, is of importance in many ways. Speciation techniques using radiation may comprise methods based on the detection of the nuclear and atomic radiations emitted in radioactive decay or methods using external sources of excitation. In the former instance, information can be obtained from the energy and intensity of radiation, but at present the partition method is still the most commonly used, although its reliability is questionable. Excitation with intense laser beams, as is currently being used for trace element analysis in photoacoustic and thermal lensing spectroscopic techniques, could conceivably be applied under suitable conditions to ultra-trace elements with a sensitivity approaching that of the radiochemical methods.

1319 **(JAERI-M—87-084) Determination of plutonium in nitric acid solution by spectrophotometry of Pu(VI). (2).** Muto, Hiroshi; Aoyagi, Hisao; Yoshida, Zenko. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 13p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750296/JAW.

Effects of co-existing agent and of Pu(IV)-polymer formation on the oxidation of Pu(IV) to Pu(VI) by Ce(IV) has been investigated in connection with the spectrophotometric determination of plutonium in nitric acid solution which includes the measurement of absorbance at 833 nm due to Pu(VI) after oxidizing plutonium ion into Pu(VI). Hydrogen peroxide and nitrite ions were dealt with as interfering species because these are most main radiolysis products in nitric acid solution. If 4 times or more concentration of Ce(IV) than that of hydrogen peroxide or nitrite ion is added to the sample solution, plutonium ion can be converted to Pu(VI) quantitatively even in the presence of these agents. Plutonium(IV) forming its polymer is hard to be oxidized to Pu(VI) by Ce(IV). The oxidation rate of Pu(IV)-polymer increases with the increase of the acid concentration of the solution. It takes, however, more than 1 hour to attain complete oxidation of polymer into Pu(VI) even in 3 M nitric acid solution.

1320 **(MINTEK-M—287) Determination of cadmium in sulphide materials.** Solomons, M. (Council for Mineral Technology, Randburg (South Africa)). 10 Nov 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700131/JAW.

A spectrophotometric method was developed for the determination of cadmium in sulphide materials containing up to 200 mg of copper, iron, lead, or zinc individually or 100 mg of each of these four elements in admixture. In the method, an initial liquid-liquid extraction of cadmium from the matrix into a solution of tri-n-octylamine in benzene is followed by stripping into nitric acid. The cadmium is measured spectrophotometrically as the dithizone complex in chloroform at 518 nm. For a sample of 0,5 g, the range of the method is 2 to 24 μg of cadmium per gram of sample. The relative standard deviation and accuracy of the method were determined on a reference material of lead concentrate with a certified lead content of 64 per cent and cadmium content of 143 +- 5 μg/g (95 per cent confidence level). The accuracy of the method was found to be about 97 per cent, and the relative standard deviation was 0,018.

1321 **(MLM—3458(OP)) Simultaneous TG/DSC [thermogravimetry/differential scanning calorimetry] and TG/MS [thermogravimetry/mass spectrometry] analyses of polymeric and energetic materials.** Whitaker, R.B.; Brown, C.R.; Chang, C.; McDaniel, J.A.; Shell, T.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 18p. (CONF-870988—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000727/JAW.

From 16. annual conference of the North American Thermal Analysis Society; Washington, DC, USA (27 Sep 1987).

The utility of simultaneous thermal analysis techniques, such as TG/DSC and TG/MS, has been demonstrated for both energetic and polymeric materials. TG/DSC can assist in elucidating reaction mechanisms and determining weight losses for endothermic transitions which precede decomposition of energetic materials. The endothermic and exothermic nature of decomposition processes can be defined by TG/DSC and the decomposition products identified by TG/MS.

1322 (N—87-25884, pp 13) **Rare gas analysis of size fractions from the Fayetteville meteorite.** Jordan, J.L. Jun 1987. NTIS, PC A13/MF A01. (NASA-CR—171984-VOL-2; NAS—1.26:171984-VOL-2).

In National Aeronautics and Space Administration (NASA)/ American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, Volume 2.

Eight size separates of grains from the Fayetteville meteorite ranging from less than 20 microns to greater than 1 millimeter are being analyzed for their rare gas elemental and isotopic composition. Measurements on five samples were performed. All five reveal a mixture of solar, planetary, cosmic ray produced and radiogenic gases. The solar component is of particular interest since it suggest that the meteorite may represent a fragment of an ancient protoplanetary regolith which was exposed to the solar wind. Solar wind elements are implanted in the outer few hundred Angstroms of exposed grains and are therefore expected to be surface correlated. At present the data do not suggest that such a correlation exists, but the final conclusion must await further analyses and data reduction.

1323 **(ORNL/TM—10318) Separation of sugars by continuous annular chromatography.** Howard, A.J.; Carta, G.; Byers, C.H. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001524/JAW.

Continuous chromatographic separations of aqueous fructose-glucose-sucrose solutions have been investigated in a laboratory-scale continuous annular chromatograph (CAC) using calcium-exchanged Dowex 50W-X8 resin. Comparative studies have also been conducted using a conventional fixed-bed column packed with the same resin. Complete resolution of fructose-glucose mixtures could be obtained both in a 60-cm-long CAC and in a conventional column of the same length with a sugar feed concentration of up to 200 g/L. Partial resolution of sucrose in three component mixtures was also obtained, and the three sugars were completely separated from added higher-molecular-weight saccharides. Results have been analyzed in terms of approximate linear chromatographic theories and orthogonal collocation of exact mass transfer model equations for fixed and rotating beds. A systematic, comparative evaluation of factors affecting process performance and design procedures is presented.

1324 **(PNL-SA—14421) Retention processes in supercritical fluid chromatography.** Yonker, C.R.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 20p. (CONF-870410—37). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000079/JAW.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The understanding of retention processes in supercritical fluid chromatography is important for the continued growth and development of the analytical technique. Chromatographic retention has been studied using a simple thermodynamic model involving solute retention as a function of pressure and through assessment of the effect of density on the enthalpy of solute transfer between the supercritical mobile phase and bonded stationary phase. The solvatochromic behavior of solute probes in pure and binary supercritical fluids can be used to determine their polarity/polarizability as a function of density and related solvent effects on solute retention in supercritical fluid chromatography. 43 refs., 7 figs.

1325 **(SAND—87-0365C) Microstructural and chemical analysis using electron beams: The analytical electron microscope.** Romig, A.D. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 23p. (CONF-8708150—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000923/JAW.

From 36. annual Denver X-ray conference; Denver, CO, USA (3 Aug 1987).

This plenary paper is intended to be an introduction to the capabilities and limitations of analytical electron microscopy (AEM). The description to be given assumes no prior knowledge of AEM or any other electron microscopy, scanning or transmission. However, a basic understanding of x-ray generation and detection will be assumed. The power of AEM lies in its ability to collect microstructural, chemical and crystallographic information simultaneously at a fine spatial scale (<1 μm) unattainable by other analytical techniques. The most important aspects of AEM will be described, including: (1) AEM electron optics, (2) electron/beam specimen interactions, (3) electron diffraction and imaging in the AEM, (4) x-ray microanalysis and (5) electron energy loss spectroscopy. The orientation of the paper is practical, rather than theoretical, and emphasizes the fundamental concepts and implementation of each technique. 12 refs., 9 figs.

1326 **Feasibility of hydroxyl concentration measurements by laser-saturated fluorescence in high-pressure flames.** Carter, C.D.; Salmon, J.T.; King, G.B.; Laurendau, N.M. (Purdue University, School of Mechanical Engineering, West Lafayette, Indiana 47907). *Applied Optics;* **26**: No. 21, 4551-4562(1 Nov 1987).

A feasibility study has been performed on the application of laser-saturated fluorescence (LSF) to the measurement of OH concentration in high-pressure flames. Using a numerial model for the collisional dynamics of the OH molecule under nonuniform laser excitation, we have investigated the effect of pressure on the balanced cross-rate model and determined the sensitivity of the depopulation of the laser-coupled levels to the ratio of rate coefficients describing (1) electronic quenching of the vibrational levels for which $v'' > 0$ and (2) vibrational relaxation from $v'' > 0$ to $v'' = 0$. At sufficiently high pressures in near-saturated conditions, the total population of the laser-coupled levels reaches an asymptotic value, which is insensitive to the degree of saturation. When the ratio of electronic quenching is vibrational relaxation is small and the rate coefficients for rotational transfer in the ground and excited electronic states are nearly the same, the balanced cross-rate model remains a good approximation for all pressures. When the above ratio is large, depopulation of the laser-coupled levels becomes significant at high pressures, and thus the balanced cross-rate model no longer holds. In these conditions, however, knowledge of the asymptotic value achieved by the laser-coupled levels could be used to correct the balanced cross-rate model and thus allow LSF measurements at sufficiently high pressures.

1327 **Measurement of vapor deposition and extraction recovery of polycyclic aromatic hydrocarbons adsorbed on particulate solids.** Engelbach, R.J.; Garrison, A.A.; Wehry, E.L.; Mamantov, G. (Univ. of Tennessee, Knoxville). *Analytical Chemistry;* **59**: No. 20, 2541-2543(15 Oct 1987). Contract AS05-81ER60006.

Polycyclic aromatic hydrocarbons (PAHs), released (in the vapor phase) into the atmosphere via combustion of fossil fuels, are believed to adsorb on atmospheric particulate surfaces. The chemical behavior of an adsorbed PAH is strongly dependent on the characteristics of the adsorbent. Studies of chemical transformations of adsorbed PAHs usually require that the PAHs and/or their transformation products be extracted from the adsorbent and then analyzed by conventional spectrometric or chromatographic methods. Some adsorbents (especially coal ashes and other carbonaceous substrates) retain PAHs with such avidity that recoveries by conventional solvent (or even supercritical fluid) extractions are much less than 100%. Measurement of extraction recovery is straightforward when a PAH is adsorbed onto a particular solid from a liquid solution but is less facile when the adsorbate is deposited onto the adsorbent from the vapor phase. (For example, radiotracer techniques are not readily applicable with adequate safety to vapor-deposition experiments). Herein the authors describe techniques for measuring the quantity of organic adsorbate vapor that deposits on a particulate solid an determining the subsequent recovery of that adsorbate by extraction. The principal component of the apparatus is a gas-chromatographic flame ionization detector (FID), used to measure the mass flow rate of PAH to which the adsorbent; the chemical reactivity of pyrene adsorbed on particulate solids has been studied extensively.

1328 **Analysis of geological samples by hollow cathode plume.** Marcus, R.K.; Harrison, W.W. (Univ. of Virginia, Charlottesville). *Analytical Chemistry;* **59**: No. 19, 2369-2373(1 Oct 1987).

The hollow cathode plume (HCP) was applied to the elemental analysis of geological materials by atomic emission. Graphite, silver, and copper were studied as matrix materials to produce conducting electrodes from geological/matrix mixtures. Data taken from a range of sample-to-matrix ratios showed that a 10% sample composition was optimum. Reproducibility of HCP data was ap-

proximately 5%. Simulated analyses of NBS geological samples were undertaken by the developed procedures.

1329 **Interactions of compounds adsorbed on an 80% α-cyclodextrin-sodium chloride mixture investigated by diffuse.** Bello, J.M.; Hurtubise, R.J. (Univ. of Wyoming, Laramie). *Analytical Chemistry;* 59: No. 19, 2395-2400(1 Oct 1987). Contract FG02-86ER13547.

The interactions of α-cyclodextrin-analyte responsible for the luminescence phenomenon observed from compounds adsorbed on an 80% α-cyclodextrin-sodium chloride mixture were compared with the interactions of the prepared solid-phase α-cyclodextrin complexes of the compounds. Diffuse reflectance spectrometry and luminescence spectrometry were used in the study. The luminescence data with benzo[f]quinoline (B(f)Q) indicated that the nitrogen-containing ring of B(f)Q was inside the α-cyclodextrin cavity in the 80% mixture, while in the prepared inclusion compound the pyridinic nitrogen was outside the α-cyclodextrin cavity. The diffuse reflectance spectra of several compounds adsorbed on an 80% α-cyclodextrin-sodium chloride mixture and on NaCl were compared. Some of the compounds showed a red shift in their reflectance band maximum, and other compounds showed well-resolved vibronic bands on the 80% α-cyclodextrin mixture. In addition, the amount of unbound analyte on the α-cyclodextrin-sodium chloride matrix was determined.

1330 **Preparation and evaluation of slurry-packed capillary columns for normal-phase liquid chromatography.** Andreolini, F.; Borra, C.; Novotny, M. (Indiana Univ., Bloomington). *Analytical Chemistry;* 59: No. 19, 2428-2432(1 Oct 1987). Contract FG02-84ER60215.

Effective procedures have been developed to pack fused silica (capillary) columns with 5-μm particles of silica adsorbent and other polar materials (diol-, cyano-, and amino-bonded phases). Microcolumns exhibiting overall efficiencies between 70,000 and 90,000 theoretical plates were prepared. The reduced plate heights, separations impedance, and sample capacity of such columns were further evaluated.

1331 **Ion exchange resins for trapping gases: carbonate determination.** Siemer, D.D. (Idaho National Engineering Lab., Idaho Falls). *Analytical Chemistry;* 59: No. 19, 2439-2441(1 Oct 1987). Contract AC07-84ID12435.

Ion exchange resin beads have a number of features which make them potentially useful in gas analyses. First, moist resin bead beds are extremely efficient at capturing any gases capable of undergoing acid/base type reactions with the counterion occupying the exchange sites. Second, the capacities of the resin beds for these gases are both quite high and readily predictable from simple stoichiometry. Third, ions formed on the resins by the adsorption reactions can be readily eluted and then determined by classical chemical methods. Finally, the resins themselves are relatively inexpensive, easily regeneratable after use if so desired, and commercially available in a wide range of uniform particle sizes. Probably the most serious practical limitation is that the resin must not totally dry out.

1332 **Atomic absorption determination of tin using in situ concentration of stannane in a graphite furnace.** Sturgeon, R.E.; Willie, S.N.; Berman, S.S. (National Research Council of Canada, Ottawa, Ontario). *Analytical Chemistry;* 59: No. 19, 2441-2444(1 Oct 1987).

Tin is one of the more difficult elements to determine in environmental materials. Extremely low concentrations (nanograms per gram) in food products, plant and animal tissues, and aquatic samples coupled with the ubiquitous nature of this element and the ease with which laboratory reagents and vessels can become significant sources of contamination necessitate constant vigilance on the part of the analyst. Atomic absorption spectroscopy (AAS) is the most widely used technique for such determinations and considerable improvements in detection capability can be gained by conversion of the element to stannane prior to atomization. This report details the application of in situ metal trapping to the determination of total Sn in marine biological tissues and sediments by hydride generation graphite furnace AAS and its potential use as a rapid screening technique for SN in seawater.

1333 **Determination of metal ions by high-performance liquid chromatographic separation of their hydroxamic acid chelates.** Palmieri, M.D.; Fritz, J.S. (Iowa State Univ., Ames). *Analytical Chemistry;* 59: No. 18, 2226-2231(15 Sep 1987). Contract W-7405-ENG-82.

Metal ions are determined by adding N-methylfurohydroxamic acid to an aqueous sample and then separating the metal chelates by direct injection onto a liquid chromatographic column. Separations on a C_8 silica column and a polystyrene-divinylbenzene column are compared, with better separations seen on the polymeric column. The complexes formed at low pH values are cationic and are separated by an ion pairing mechanism. Retention times and selectivity of the metal complexes can be varied by changing the pH. Several metal ions can be separated and quantified; separation conditions, linear calibration curve ranges, and detection limits are presented for Zr(IV), Hf(IV), Fe(III), Nb(V), Al(III), and Sb(III). Interferences due to the presence of other ions in solution are investigated. Finally, an antiperspirant sample is analyzed for zirconium by high-performance liquid chromatography.

1334 **Direct detection of vacuum ultraviolet radiation through an optical sampling orifice: analytical figures of merit for the nonmetals, metalloids, and selected metals by inductively coupled plasma atomic emission spectrometry.** LaFreniere, B.R.; Houk, R.S.; Fassel, V.A. (Iowa State Univ., Ames). *Analytical Chemistry;* 59: No. 18, 2276-2282(15 Sep 1987). Contract W-7405-ENG-82.

Vacuum ultraviolet (vacuum UV) radiation can be readily observed through a sampling orifice inserted directly into an Ar inductively coupled plasma. Limits of detection are 50 ng mL^{-1} for the resonance lines of Br and Cl during injection into the plasma of aerosols of aqueous solutions generated by pneumatic nebulization. With ultrasonic nebulization, the detection limits improve to 8 ng mL^{-1} for Br and 15 ng mL^{-1} for Cl. Analytical calibration curves are linear over a range of 3.5-4 orders of magnitude in concentration. Each of the group IIIB (group 13 in 1985 notation) elements (Al, Ga, and In) possesses at least one intense line in the vacuum UV region that yields better limits of detection than the conventional ultraviolet lines typically observed. Emission signals from Br, Cl, and Al are not strongly affected by high concentrations of Na. The interference induced by Ca on Al emission (and vice versa) in the vacuum UV region is similar under this mode of observation to that describe in the literature for observation of the normal UV lines either axially or conventionally (i.e., from the side).

1335 **Ultra-high-resolution daughter ion tandem mass spectra using a differentially pumped dual cell fourier transform mass spectrometer.** Wise, M.B. (Oak Ridge National Lab., TN). *Analytical Chemistry;* 59: No. 18, 2289-2293(15 Sep 1987). Contract AC05-84OR21400.

An experiment sequence has been developed for the Nicolet FTMS-2000 differentially pumped, dual cell Fourier transform mass spectrometer (FTMS) that enables ultra-high-resolution daughter ion MS/MS spectra to be easily acquired without requiring pulsed valves for collision gas introduction. Full advantage is taken of the differential pumping capability of the spectrometer by forcing and dissociating ions in the high-pressure source cell, then pulsing the daughter ions across the conductance limit into the lower pressure analyzer cell where they are detected. Under these low-pressure conditions it is possible to obtain ultra-high-resolution spectra and exact mass measurements of the daughter ions. By the use of this approach, resolution in excess of 200,000 (fwhm) has been demonstrated for isobaric daughter ions at m/z 105. Both positive and negative ion collision induced dissociation (CID) spectra have been successfully generated.

1336 **Scintillation-type ion detection for inductively coupled plasma mass spectrometry.** Huang, L.; Jiang, S.; Houk, R.S. (Iowa State Univ., Ames). *Analytical Chemistry;* 59: No. 18, 2316-2320(15 Sep 1987). Contract W-7405-ENG-82.

Inductively coupled plasma mass spectrometry (ICP-MS) has become an important new technique for elemental and isotopic analysis. In all the ICP-MS instruments constructed to date, the ion signals are monitored by an electron multiplier, which is generally of the Channeltron variety. A Channeltron has a limited lifetime of

approximately 1 year under normal analytical use. The general use of pulse counting techniques, in which a high bias voltage is applied to the multiplier so that its gain is saturated, probably accelerates the rate of gain loss. The response of a Channeltron is linear up to count rates of approximately 1 x 10^6 counts s^{-1}; above this value, calibration curves tend to droop. Deviation from linear response at high count rates particularly limits the concentration range over which either very large or very small isotope ratios may be determined and can be a source of error when isotope dilution is employed for quantitation. A scintillation-type detector offers some potential advantages in the problem areas identified for Channeltron electron multipliers. At the very least, the gain of the scintillation detector should not deteriorate with time. In the present work, the analytical figures of merit of a scintillation-type detector are compared with those of a Channeltron for ICP-MS.

1337 **Inductively coupled plasma mass spectrometery: an overview.** Houk, R.S. (Ames Lab., IA). pp vp of Pittsburgh conference & exposition - on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

A general description of the instrumentation for an d analytical capabilities of ICP-MS will be given. The following areas will be emphasized: (1) characteristics of the ICP that make it an effective ion source; (2) extraction of ions from the ICP and the fundamental processes occurring therein; (3) techniques for focusing, mass analyzing, and detecting ions; (4) use of ICP-MS as an element or isotope-selective detector for chromatography; (5) sources of interferences and experimental ways to alleviate their effects; (6) isotope labelling studies of trace element metabolism in human nutrition; (7) representative analytical applications; and (8) diagnostic studies of ICPs by MS. Finally, the experimental techniques developed for ICP-MS have led to some innovative ways to observe emission from ICPs (direct probe sampling, extraction discharge emission, and afterglow emission), which will be described briefly.

1338 **Liquid membrane coated ion-exchange column solids.** Barkey, D.P. (to Dept. of Energy). US Patent Application 6-922,426. 23 Oct 1986. 20p. Contract AC03-76SF00098. DE88000836 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000836/JAW.

This invention relates to a method for improving the performance of liquid membrane separations by coating a liquid membrane onto solid ion-exchange resin beads in a fixed bed. Ion-exchange beads fabricated from an ion-exchange resin are swelled with water and are coated with a liquid membrane material that forms a film over the beads. The beads constitute a fixed bed ion-exchange column. Fluid being treated that contains the desired ion to be trapped by the ion-exchange particle is passed through the column. A carrier molecule, contained in the liquid membrane ion-exchange material, is selective for the desired ion in the fluid. The carrier molecule forms a complex with the desired ion, transporting it through the membrane and thus separating it from the other ions. The solution is fed continuously until breakthrough occurs at which time the ion is recovered, and the bed is regenerated.

1339 **Method for the concentration and separation of actinides from biological and environmental samples.** Horwitz, E.P.; Dietz, M.L. (to Dept. of Energy). US Patent Application 6-921,282. 21 Oct 1986. 21p. Contract W-31109-ENG-38. DE88000880 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000880/JAW.

A method and apparatus for the quantitative recovery of actinide values from biological and environmental sample passes appropriately prepared samples in a mineral acid solution through a separation column of a dialkyl(phenyl)-N,N-dialylcarbamoylmethylphosphine oxide dissolved in tri-n-butyl phosphate on an inert substrate which selectively extracts the actinide values. The actinide values can be eluted either as a group or individually and their presence quantitatively detected by alpha counting.

4002 Inorganic, Organic And Physical Chemistry

REFER ALSO TO CITATION(S) 17, 41, 207, 448, 449, 1184, 1232, 1236, 1237, 1742, 1812, 1836, 1861

1340 **(AD-A—182964/7/XAB) Optical probes of interlamellar redox chemistry: intercalation of the Creutz-Taube complex into hydrogen uranyl phosphate. Technical report.** Verschoor, C.M.; Ellis, A.B. (Wisconsin Univ., Madison (USA). Dept. of Chemistry). 8 Jul 1987. 15p. (UWIS/DC/TR—87/1). NTIS, PC A02/MF A01.

Hydrogen uranyl phosphate (HUP) can be intercalated by the Creutz-Taube (C-T) complex, $Ru(NH_3)52(mu\text{-}pyrazine)\ 5^+$, to yield hydrated, partially-substituted lamellar solids, H(C-T)UP, of approximate composition $H(1\text{-}5x)(C\text{-}T)xUO_2PO_4$ ($0.001 < x < 0.01$). The more-crystalline samples exhibited an X ray powder pattern similar to that of HUP: the structure can be indexed in tetragonal symmetry and possesses an interlamellar spacing of approx. 8.69 A. The absorption spectrum of H(C-T)UP appears to be a simple superposition of bands due to the UO^{2+} moiety and the C-T complex. Photoluminescence (PL) of H(C-T)UP is quenched relative to HUP; PL decay curves are nonexponential and span a shorter time domain relative to HUP. Exposure of H(C-T)UP to Br_2 vapor causes the purple solid to become yellow. The spectral changes are consistent with redox chemistry wherein the intercalated C-T complex undergoes oxidation. For most samples examined, the PL decay times were enhanced upon oxidation.

1341 **(AD-A—182965/4/XAB) Comparison of reactivity based on intercalation and host-lattice reconstruction. Two routes for the conversion of the lamellar solid hydrogen uranyl phosphate to a lamellar hydrate of uranyl phosphate. Technical report.** Rosenthal, G.L.; Ellis, A.B. (Wisconsin Univ., Madison (USA). Dept. of Chemistry). 8 Jul 1987. 10p. (UWIS/DC/TR—87/3). NTIS, PC A02/MF A01.

The lamellar solid hydrogen uranyl phosphate can be quantitatively converted to a lamellar hydrate of uranyl phosphate by two routes: an intercalative ion-exchange reaction with aqueous uranium oxide ions and thermal decomposition in an aqueous slurry. An x ray powder pattern of the product can be indexed in tetragonal symmetry with an interlammelar spacing of 11.1 angstrom, expanded from a valve of 8.69 angstrom in hydrogen uranyl phosphate (HUP). Conversion of HUP to UP is accompanied by a drastic diminution in photoluminescence lifetime and intensity. Arrhenius parameters derived from the rates of the intercalation and thermal decomposition reactions indicate that they proceed by quite different mechanisms: the intercalation reaction proceeds with an apparent activation energy, of 12 plus or minus 2 kilocalories/mole and is characterized by a value of 30 plus or minus 2 kilocalories/mole. Samples of UP, obtained by either method, can be converted back to HUP by the action of dilute phosphoric acid in an aqueous slurry at room temperature. Possible mechanisms for these reactions are discussed.

1342 **(AERE-R—12489) Sodium aerosol formation in an argon flow over hot sodium.** Clement, C.F.; Dolias, M.J. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Jan 1987. 14p. (DRNR/SDEC/LETT-NT—87.082). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752851/JAW.

Vapour evaporation, which partly forms aerosol, occurs when a cold gas flows over a hot liquid. A previous well-mixed model is extended to predict the final vapour plus aerosol content of such a flow in terms of its initial and final temperatures. The predictions are compared to results of the Copacabana II experiment in which argon passed over a sodium pool. Agreement is obtained for the final sodium density at moderate flow rates, and physical reasons are given as to why deviations occur at low and high flow rates.

1343 (BMFT-FB-T—86-246) Development of special surfactants with high temperature and hydrolytic stability for various EOR-procedures. Final report. Lange, F.; Herold, C.P. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Henkel K.G.a.A., Duesseldorf (Germany, F.R.)). Dec 1986. 33p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753257/JAW.

Various ether sulfonates with differing C-chains and degrees of ethoxylation have been synthesized. Orientating tests of the properties of these products showed good stability (half life at pH 3.5 and 180/sup 0/C: 300-600 days). Products with a higher degree of ethoxylation are easily soluble at high salinities. Foaming properties are similar to the analogous ether sulfates. Some special types give interesting phase behaviour with broad microemulsion domains. With 17 refs., 18 figs.

1344 (BNL—40282) Kinetic studies of elementary reactions using the flash photolysis-shock tube technique. Sutherland, J.W.; Klemm, R.B. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 11p. (CONF-870737—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001337/JAW.

From 16. shock tube symposium; Aachen, F.R. Germany (26 Jul 1987).

The development of the flash photolysis-shock tube technique is reviewed and the advantages and limitations of the method are discussed. Kinetic obtained with the Brookhaven FP-ST facility over the 800K to 2500K temperature range, are described for the following atom-molecule reactions: (1) $H + NH_3 \rightarrow NH_2 + H_2$; (2) $O + CH_4 \rightarrow OH + CH_3$; (3) $O + H_2 \rightarrow OH + H$; (4) $H + H_2O \rightarrow OH + H_2$; (5) $H + O_2 \rightarrow OH + O$; (6) $H + O_2 + M \rightarrow HO_2 + M$; (7) $O + C_2H_4 \rightarrow$ Products. The results obtained in this laboratory for reactions (1), (2), (3) and (7) are compared with those reported previously. 26 refs., 6 figs.

1345 (CEA-CONF—8846) Isotope separation by ionic cyclotron resonance. Compant La Fontaine, A.; Gil, C.; Louvet, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Oct 1986. 22p. (CONF-8609317—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752902/JAW.

From Franco- German colloquium on recent advances and stable isotope use; Pont-a-Mousson, France (28 Sep 1986).

The principle of the process of isotopic separation by ionic cyclotron resonance is explained succinctly. The theoretical calculation of the isotopic effect is given as functions of the electric and magnetic fields in the frame of single particle approximation and of plasma collective theory. Then, the main parts of the demonstration device which is in operation at the CEA, are described here: the supraconducting magnetic field, the used diagnostics, the principle of the source and the collecting apparatus. Some experimental results are given for chromium. The application of the process to ponderal separation of metal isotopes, as Chromium, Nickel, Molybdenum ... is discussed in view of production: of medical, structural and irradiation isotopes.

1346 (CONF-871027—33) High temperature vaporization/decomposition of lanthanide and actinide fluorides. Gibson, J.K.; Haire, R.G. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014938/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The Knudsen effusion-mass spectrometric technique has been used in this laboratory to study the congruent vaporization and thermal decomposition of several lanthanide and actinide fluorides. Reported here are the results of experiments which were performed to establish the thermal stability of AmF_4(s) and CeF_4(s). Cerium tetrafluoride thermally decomposed in the region of 700°C. Americium tetrafluoride thermally decomposed in the region of 600°C. 11 refs., 1 fig., 1 tab.

1347 (DOE/ER/13154—10) Experimental and theoretical study of condensation in multicomponent vapors: Quarterly report No. 10, 15 May 1986-14 August 1986. Waterhouse, R.; Frish, M.B.; Wilemski, G. (Physical Sciences, Inc., Andover, MA (USA)). Jul 1987. Contract AC02-84ER13154. 12p. (PSI-TR—154/696). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000896/JAW.

This report covers the work performed during the tenth quarter of a multiyear program to study condensation in multi-component vapors. We discuss modifications that have been made to our experimental apparatus to improve the reliability and resolution of our data. New data for the ethanol, water, and ethanol-water systems are presented.

1348 (DOE/ER/13154—11) Experimental and theoretical study of condensation in multicomponent mixtures: Quarterly report No. 11, 15 August 1986-14 November 1986. Frish, M.B.; Waterhouse, R.; Wilemski, G. (Physical Sciences, Inc., Andover, MA (USA)). Jul 1987. Contract AC02-84ER13154. 18p. (PSI-TR—154/710). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000897/JAW.

This report covers work performed during the eleventh quarter of a multi-year program to study condensation in multicomponent vapors. The program is primarily experimental, but a significant amount of theoretical work is also being performed. The experiments are studying the homogeneous nucleation and subsequent growth of mixed clusters formed during supersonic expansion of gas mixtures containing mutually condensible species. Herein we describe newly developed data analysis procedures for determining particle sizes and number densities throughout the region of the nozzle where vapor condenses rapidly. These are the first experiments capable of obtaining this information without resorting to theoretical models and approximations.

1349 (DOE/ER/13443—2) Thermodynamic properties of supercritical mixtures: Progress report for the period 1 September 1986-15 September 1987. Christensen, J.J.; Izatt, R.M. (Brigham Young Univ., Provo, UT (USA)). 18 Sep 1987. Contract FG02-85ER13443. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000809/JAW.

The primary goal of this research effort is to gain increased understanding of the energetics associated with chemical and physical interactions involving supercritical and near-supercritical fluids. Emphasis has been placed on reactions involving CO_2, fluorocarbons, and hydrocarbons. Heat of mixing(H/sup E/) values have been determined for several binary systems involving these three classes of compounds and manuscripts have been prepared which report the experimental results. The flow calorimeter and operating procedures have been modified to allow ternary systems to be studied. An extensive investigation of the ternary system, CO_2 + n-hexane + toluene, has been completed over wide temperature and pressure ranges. In addition, the system (CO_2 + hexane) has been studied as a function of temperature and pressure with the following additives present in the CO_2 stream at five mole percent: CH_3OH, octanol, n-octane.

1350 (DOE/ER/13671—1) Spectroscopic and dynamical studies of highly energized small polyatomic molecules: Technical progress report, February 1, 1987-September 30, 1987. Field, R.W.; Kinsey, J.L.; Silbey, R.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 1987. Contract FG02-87ER13671. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000802/JAW.

SEP studies of acetylene X-tilde $^1\Sigma$/sub g/$^+$ have progressed in several directions: vinylidene-acetylene isomerization, SEP spectroscopy of HCCD, and on a new limit for the C-H bond energy in acetylene. The first of these has been the most extensively studied.

1351 (INIS-mf—10986) Thermochemical investigations on uranyl phosphates and arsenates. Barten, H. (Amsterdam Univ. (Netherlands)). 29 Oct 1986. 147p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703573/JAW.

Results are described of a study of the thermochemical stability of anhydrous phosphates and arsenates. The results of phase studies deal with compound formation and characterization, coexisting phases and limiting physical or chemical properties. The uranyl phosphates evolve oxygen at higher temperatures and the arsenates lose arsenic oxide vapour. These phenomena give the possibility to describe their thermodynamic stabilities. Thus oxygen pressures of uranyl phosphates have been measured using a static, non-isothermal method. Having made available the pure anhydrous compounds in the course of this investigation, molar thermodynamic quantities have been measured as well. These include standard enthalpies of formation from solution calorimetry and high-temperature heat-capacity functions derived from enthalpy increments measured. Some attention is given to compounds with uranium in valencies lower than six which have been met during the investigation. An evaluation is made of the thermodynamics of the compounds studied, to result in tabulized high-temperature thermodynamic functions. Relative stabilities within the systems are discussed and comparisons of the uranyl phosphates and the arsenates are made. (Auth.). Includes Dutch summary

1352 **(INIS-SU—423) 11. All-union conference on calorimetry and chemical thermodynamics. Pt. 1. Summaries of reports.** (AN SSSR, Moscow; AN SSSR, Novosibirsk. Inst. Neorganicheskoj Khimii). 1986. vp. (In Russian). (CONF-8606301—Pt.1-Summs.). NTIS (US Sales Only), PC A11/MF A01. Order Number DE87780174/JAW.

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

Thirty-three papers from Part 1 of the All-Union Conference on Calorimetry and Chemical Thermodynamics are summarized. Thermodynamic properties of chlorides, fluorides, rare earths, and other compounds are investigated in these studies.

1353 **(LBL—23943) Ab initio theoretical methods for excited states application to ketene and formaldehyde.** Allen, W.D. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 192p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88001388/JAW.

Extensive ab initio studies of the X-tilde$^1A_1$, a-tilde$^3A_2$ ($^3A''$), A-tilde$^1A_2$ ($^1A''$), b-tilde$^3A_1$ ($^3A'$), B-tilde$^1B_1$, and 2^1A_1 electronic states of ketene have been performed with the goal of providing an essentially complete theoretical description of these low-lying states. Geometrical structures, vertical and adiabatic excitation energies, and vibrational frequencies have been determined for these states, and correlation diagrams and transition states for dissociation to methylene and carbon monoxide have been investigated in detail. The theoretical results are discussed in the context of ketene as a paradigm of five features exhibited in general by certain electronic states: the correlation of excited states to fragments, gross qualitative differences between singlet and triplet states with the same orbital occupancies, conical intersections of potential energy surfaces, variational collapse of trial wave functions, and Rydberg-valence mixing. A new, optimally efficient formalism is presented for the analytic evaluation of two-configuration self-consistent-field configuration interaction (TCSCF-CI) energy first derivatives, and this TCSCF-CI gradient procedure is adapted and applied to singlet excited electronic states of the same symmetry as the ground state. The resulting adaptation, the SCFX-CI gradient procedure, is the simplest means by which dynamical electron correlation can be incorporated effectively for such electronic states, because conventional SCF-CI wave functions are unreliable in these cases due to the possibility of variational collapse. In addition to the 2^1A_1 state of ketene, the SCFX-CI and TCSCF-CI gradient methods are applied to the X-tilde$^1A_1$, ($\pi \rightarrow \pi^*$) 2^1A_1, and ($n \rightarrow$ 3p/sub y/) 2^1A_1 states of formaldehyde. Specifically, geometrical structures, excitation energies, and harmonic vibrational frequencies obtained with DZP and DZP + R basis sets are reported for H_2CO.

1354 **(N—87-26231) Tribological behavior of polyphenyl ether and polyphenyl thioether aromatic lubricants.** Jones, W.R. Jr. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1987. 231p. (NASA-TM—100166; E—3424; NAS—1.15:100166). NTIS, PC A11/MF A01.

The tribological behavior of several polyphenyl ethers and polyphenyl thioethers is reported. Tribological areas covered include: surface tension and wettability measurements, boundary lubrication, ferrography, thermal and oxidative stability and chemiluminescence.

1355 **(N—87-26531, pp vp) Chemical network problems solved on NASA/Goddard's massively parallel processor computer.** Cho, S.Y.; Carmichael, G.R. Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

The single instruction stream, multiple data stream Massively Parallel Processor (MPP) unit consists of 16,384 bit serial arithmetic processors configured as a 128 x 128 array whose speed can exceed that of current supercomputers (Cyber 205). The applicability of the MPP for solving reaction network problems is presented and discussed, including the mapping of the calculation to the architecture, and CPU timing comparisons.

1356 **Bond paths and bond properties of carbon-lithium bonds.** Ritchie, J.P.; Bachrach, S.M. (Los Alamos National Lab., NM). *Journal of the American Chemical Society;* **109**: No. 20, 5909-5916(30 Sep 1987).

Twenty-three organolithium compounds were analyzed by using the topological theory of molecular structure. The geometry of each compound was first optimized, making use of the 3-21G basis set. Then integrated lithium charges and quantities characterizing the carbon-lithium bond critical point, such as rho/sub c/ (C-Li), del^{2}rho/sub c/(C-Li), and the local energy density, were calculated. The results confirm the nature of the carbon-lithium bond to be primarily ionic. Bond path networks of these compounds were also calculated and proved surprising. Coordination numbers of lithium, as assigned by the topological theory, range from one to four. Similarly defined coordination numbers of carbon range as high as nine. Unexpectedly, some putatively bridging lithiums are not bridging in a topological sense. Additional unexpected features of the bond path networks are bond paths connecting essentially neutral carbons with lithiums and bond paths connecting highly negatively charged carbons that are widely separated. No lithium-lithium bond paths are found. Finally, unstable topological structures occur at potential energy minima. Polarization of electrons toward what are essentially lithium cations accounts for the carbon-lithium bond paths observed.

1357 **Barriers to rotation adjacent to double bonds. 3. The C-O barrier in formic acid, methyl formate, acetic acid, and methyl acetate. The origin of ester and amide resonance.** Wiberg, K.B.; Laidig, K.E. (Yale Univ., New Haven, CT). *Journal of the American Chemical Society;* **109**: No. 20, 5935-5943(30 Sep 1987).

The structures of the rotamers about the C-O bonds of formic acid, methyl formate, acetic acid, and methyl acetate were calculated by using the 6-31G* basis set and complete geometrical relaxation. Large basis sets (6-311+G**) and correction for electron correlation were needed in order to obtain calculated barriers that were in good agreement with the available experimental data. The factors that control the geometry at a carbonyl group are considered, and it is shown that an analysis in terms of bond path angles leads to a direct connection with electronegativity. The nature of the interaction between an amino group and a carbonyl, as in an amide, is examined and shown not to involve charge transfer from the nitrogen to the carbonyl oxygen, but rather it involves charge transfer between carbon and nitrogen. The origin of the rotational barrier in esters and of the difference in energy between the E and Z conformers is discussed.

1358 **Carbanion spectroscopy: CH_2CN^-.** Moran, S.; Ellis, H.B. Jr.; DeFrees, D.J.; McLean, A.D.; Ellison, G.B. (Univ. of Colorado, Boulder). *Journal of the American Chemical Society;* **109**: No. 20, 5996-6003(30 Sep 1987). Contract AC02-80ER10722.

The authors have measured the photoelectron spectra of CH_2CN^- and CD_2CN^- and report the following electron affinities:

EA(CH_2CN) = 1.543 +/- 0.014 eV and EA(CD_2CN) = 1.538 +/- 0.012 eV. From an analysis of the peak splittings and intensities, they extract potential-energy curves for the umbrella mode of the CH_2CN^- negative ion and the CH_2CN radical. The radical is found to be a planar, C/sub 2v/ species. The structure of the cyanomethide ion is almost described as $CH_2{=}C{=}N^-$, but the hydrogens are bent slightly out of the molecular plane. A Franck-Condon analysis leads to a value of the out-of-plane deformation angle as 30 +/- 5° with a very small inversion barrier of 100 +/- 50 cm^{-1}. Their structural conclusions are reinforced by a series of ab initio Hartree-Fock and Moeller-Plesset perturbation calculations on both the cyanomethyl radical and cyanomethide ion. Using the gas-phase acidity of CH_3CN, they obtain the following bond-dissociation energy for acetonitrile: $DH°_{298}$ (H-CH_2CN) = 94.2 +/- 2.0 kcal/mol.

1359 **Carbanion spectroscopy: $^-CH_2NC$.** Moran, S.; Ellis, H.B. Jr.; DeFrees, D.J.; McLean, A.D.; Paulson, S.E.; Ellison, G.B. (Univ. of Colorado, Boulder). *Journal of the American Chemical Society;* **109**: No. 20, 6004-6010(30 Sep 1987). Contract AC02-80ER10722.

Photoelectron spectroscopy has been used to measure the electron affinities of the isocyanomethyl radicals: EA(CH_2NC) = 1.059 +/- 0.024 eV and EA(CD_2NC) = 1.070 +/- 0.024 eV. A Franck-Condon analysis of their spectra suggests that the isocyanomethide anion ($^-CH_2NC$) is a pyramidal species and a localized ion. This ion is bent out of the plane by 56 +/- 5° with an inversion barrier of 650 +/- 50 cm^{-1}. These structural conclusions are examined by a series of ab initio Hartree-Fock and Moeller-Plesset perturbation calculations on both the isocyanomethyl radical and isocyanomethide ion. Using the gas-phase acidity of CH_2NC, they obtain the following bond-dissociation energy: $DH°_{298}$(H-CH_2NC) = 84.8 +/- 3.1 kcal/mol. These results are used to compute the isomerization energies for $^-CH_2NC \rightarrow CH_2CN^-$ and $CH_2NC \rightarrow CH_2CN$. These values are compared to other isocyano/cyano isomerizations.

1360 **Intramolecular coupling of eta^2-iminoacyl and eta^2-acyl functions at group 4 and group 5 metal centers: structure and spectroscopic properties of the resulting enamidolate and enediamide complexes.** Chamberlain, L.R.; Durfee, L.D.; Fanwick, P.E.; Kobriger, L.M.; Latesky, S.L.; McMullen, A.K.; Steffey, B.D.; Rothwell, I.P.; Folting, K.; Huffman, J.C. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **109**: No. 20, 6068-6076(30 Sep 1987). Contract FG22-85PC80909.

During their studies of the early d-block metal chemistry associated with aryloxide ligation they have examined the reactivity of a series of mixed alkyl, aryloxide compounds toward CO and the isoelectronic organic isocyanide molecule. This has allowed them to isolate and study in detail a series of compounds containing a number of eta^2-iminoacyl functions. Furthermore they have demonstrated that intramolecular coupling of iminoacyl groups to produce enediamido ligands can take place, as well as the related coupling of iminoacyl and acyl groups. They report here in detail the synthesis of a number of enamidolate and enediamido complexes using this synthetic method and also report in detail on the coordination properties of the resulting metallacycles, an area that has received recent theoretical interest. In a subsequent paper they report a kinetic investigation of these carbon-carbon bond-forming processes.

1361 **Observation of medium chain length polymethylene biradicals in liquid solutions by time resolved EPR spectroscopy.** Closs, G.L.; Forbes, M.D.E. (Univ. of Chicago, IL). *Journal of the American Chemical Society;* **109**: No. 20, 6185-6187(30 Sep 1987).

In recent years much effort has been expended on the detection of unstable biradicals by physical methods. Because of its superior time resolution, optically detected laser flash photolysis has been the method of choice for obtaining kinetic information. However, the broad solution spectra have little structural content, and the method fails entirely when the biradical has no useful absorption band. Consequently, no spectroscopic measurements of any kind have been reported on the fundamental polymethylene chain biradicals. In this communication they report the first EPR spectra of localized polymethylene biradicals obtained in liquid solution under conditions where they undergo normal fast reactions.

1362 **(MLM—3454(TR)) Calcium isotope effects in heterogeneous exchange equilibria with cryptands.** Schiefer, H.P. (Monsanto Research Corp., Miamisburg, OH (USA). Mound; Regensburg Univ. (Germany, F.R.)). 30 Sep 1987. Contract AC04-76DP00053. Translation source information not available . 213p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88000910/JAW.

The complexing reaction with $^{40}Ca^{2+}$, $^{44}Ca^{2+}$ and $^{48}Ca^{2+}$ was investigated with regard to possible isotope effects on two bicyclic amino polyethers, namely the [2 . 2 . 1] and the [2 . 2 . 2] cryptand. Various two-phase systems in which free and complexed Ca^{2+} have different distributions were tested. The [2 . 2 . 2, $Ca]^{2+}$ and [2 . 2 . 1, $Ca]^{2+}$] cryptates are absorbed on the Dowex 50 W-X 12 exchanger. In static experiments in the same system, enrichment of the heavy calcium isotopes in [2 . 2 . 1] was observed. In extraction experiments in the chloroform/water system with calcium cryptate, enrichment of $^{48}Ca^{2+}$ in the [2 . 2 . 2] complex was observed. In static experiments in cryptand exchanger [2/sub B/ . 2 . 2] polymer/methanol:chloroform (7:3) with a low water content, high isotope effects of $\epsilon(44/40) = 6.5 \cdot 10^{-3}$ and $\epsilon(48/40) = 12 \cdot 10^{-3}$ were measured. $^{48}Ca^{2+}$ is bound preferentially by the exchanger phase, whereas $^{44}Ca^{2+}$ and $^{40}Ca^{2+}$ are bound by the aqueous phase. Column experiments conducted at low water contents (1.5 to 3.5 vol % H_2O) with methanol-chloroform (7:3) eluent show broad elution bands and similar selectivities of Ca^{2+} and H_2O for the [2/sub B/ . 2 . 2) cryptands. With almost 80% enrichment of the first fraction compared with the last fraction, the highest total enrichment in liquid-solid ion exchange was achieved for $^{48}Ca^{2+}$. No isotope effects could be discerned with the chloride anion. No effect of the water content of the eluent was found. The isotope effect decreases with a drop in temperature. Reaction enthalpies and entropies were obtained for the isotope exchange reactions.

1363 **Crystal and molecular structure of bis(diisopropylphenylphosphine)hexahydridoosmium, [$OsH_6(PC_{12}H_{19})_2$]: single-crystal neutron diffraction study at 20 K.** Howard, J.A.K.; Johnson, O.; Koetzle, T.F.; Spencer, J.L. (Univ. of Bristol, England). *Inorganic Chemistry;* **26**: No. 18, 2930-2933(9 Sep 1987). Contract AC02-76CH00016.

The crystal and molecular structure of the hexahydridoosmium complex [$OsH_6(PC_{12}H_{19})_2$], determined from a low-temperature X-ray diffraction analysis, has been refined on the basis of neutron diffraction data obtained at 20 K. The dodecahedral ML_2H_6 core has approximate mm symmetry with the phosphines in equivalent B (five-neighbor) sites and a P-Os-P angle of 155.2 (1)°. The Os-H distances range from 1.637 (4) to 1.668 (4) A, with a mean value of 1.649 (5) A. Crystal data at 20.0 (5) K: a = 17.016 (3) A, b = 13.762 (3) A, c = 10.857 (3) A, β = 98.91 (2)°, V = 2512 (1) A^3, monoclinic, $P2_1/n$, Z = 4, M/sub r/ 584.8. 29 references, 2 figures, 3 tables.

1364 **Synthesis of heterometallic carbide clusters containing three iron atoms: [PPN]^2[$MFe_3(CO)_{12}C$] (M = Cr, W), [PPN]$_2$[$Cr_2Fe_2(CO)_{16}C$], $Rh_2Fe_3(CO)_{14}C$, and [PPN][$Rh_3Fe_3(CO)_{15}C$].** Hriljac, J.A.; Holt, E.M.; Shriver, D.F. (Northwestern Univ., Evanston, IL). *Inorganic Chemistry;* **26**: No. 18, 2943-2949(9 Sep 1987). Contract AC02-83ER13104;FG02-86ER13640.

Redox-condensation reactions involving [PPN]$_2$[Fe_3($CO)_9$(CCO)] and electrophilic transition-metal reagents lead to [PPN]$_2$[$MFe_3(CO)_{12}C$] (M = Cr, W), [PPN]$_2$[$Cr_2Fe_2(CO)_{16}C$], $Rh_2Fe_3(CO)_{14}C$, and [PPN][$Rh_3Fe_3(CO)_{15}C$]. Variable-temperature ^{13}C NMR spectroscopy was employed to assign the structures of the tetranuclear clusters and $Rh_2Fe^3(CO)_{14}C$ in solution. An improved synthesis of [PPN][$RhFe_3(CO)_{12}C$] and more complete variable-temperature (ca. -130 to +20 °C) ^{13}C NMR spectra of this cluster and [PPN][$MnFe_3(CO)_{12}C$] are discussed. All of the tetranuclear clusters are assigned butterfly metal geometries will the heterometals located at hinge sites. Attempts to prepare iron-molybdenum carbide clusters are discussed. The structure of [PPN][Rh_3Fe_3 ($CO)_{15}C$] was determined by a single-crystal x-ray diffraction study and was found to consist of a trigonal-antiprismatic metal array with the carbide ligand within the metal polyhedron. The iron atoms define one of the trigonal faces and the rhodium atoms define the other. Crystal data for [PPN][$Rh_3Fe_3(CO)_{15}C$]: monoclinic,

space group $P2_1/n$, a = 16.220 (6) A, b = 9.282 (3) A, c = 35.17 (3) A, β = 94.84 (5)°, Z = 4. 28 references, 5 figures, 6 tables.

1365 **Vibrational frequencies associated with the carbide ligand in iron butterfly clusters.** Stanghellini, P.L.; Sailor, M.J.; Kuznesof, P.; Whitmire, K.H.; Hriljac, J.A.; Kolis, J.W.; Zheng, Y.; Shriver, D.F. (Univ. of Sassari, Italy). *Inorganic Chemistry;* 26: No. 18, 2950-2954(9 Sep 1987). Contract AC02-83ER13104.

The vibrational frequencies associated with the exposed carbon atom in several tetranuclear iron carbide clusters with a butterfly arrangement of atoms were investigated by infrared and Raman spectroscopy. Vibrational assignments were confirmed in most cases by ^{13}C labeling of the carbide carbon atom. The characteristic feature of the iron butterfly carbides is a readily observed band in the infrared spectrum around 900 cm^{-1}. An approximate normal-coordinate analysis on these molecules yields values of the metal-carbon force constant of about 250 N m^{-1}. 29 references, 6 figures, 5 tables.

1366 **Solvent dependences of spectral and redox properties of pyrazine (pz) complexes of ruthenium and osmium pentaammines: $Ru(NH_3)_5pzCH_3^{3+}$, $Os(NH_3)_5pzCH_3^{3+}$, and $[Ru(NH_3)_5]_2pz^{6+}$.** Creutz, C.; Chou, M.H. (Brookhaven National Lab., Upton, NY). *Inorganic Chemistry;* 26: No. 18, 2995-3000(9 Sep 1987). Contract AC02-76CH00016.

Near-IR-vis spectra and cyclic voltammetric parameters are reported for the title compounds in the solvent series nitromethane, acetonitrile, propylene carbonate, N,N-dimethylformamide, and dimethyl sulfoxide (over which Gutmann donor number (DN) ranges from 2.7 to 29.8). As has been found in related systems, the E^o of $(NH_3)_5M$/sup III/II/ decreases with donor number, with the magnitude of the response to solvent being quantitatively similar (0.025 +/- 0.002 V/DN) for all of the couples examined. (Consequently the stability of $[Ru(NH_3)_5]_2pz^{6+}$ with respect to disproportionation is solvent independent within experimental error.) By contrast, the vis nu/sub h/) and near-IR (nu_1) absorption bands exhibit very different solvent dependences. For $Ru(NH_3)_5pzCH_3^{3+}$, the position of nu/sub h/ is solvent independent, but nu_1 exhibits a typical MLCT solvent dependence. For $Os(NH_3)_5pzCH_3^{3+}$, nu_1 shifts to longer wavelength with increasing donor number (MLCT character) while nu/sub h/ exhibits the opposite behavior. Both vis and near-IR bands of $[Ru(NH_3)_5]_2pz^{6+}$ shift only very slightly with solvent, but the vis band of $[Ru(NH_3)_5]_2pz^{6+}$ is more solvent dependent - about 80% as much as $Ru(NH_3)_5pz^{2+}$. The spectral shifts are discussed in terms of a simplified molecular orbital scheme for the M-pz backbonding interaction, and the nature of the solvent sensitivity is found to be related to the metal and pyrazine character of the MO's involved in the transition. 51 references, 5 figures, 4 tables.

1367 **Furanose ring conformation: the application of ab initio molecular orbital calculations to the structure and dynamics of erythrofuranose and threofuranose rings.** Serianni, A.S.; Chipman, D.M. (Univ. of Notre Dame, IN). *Journal of the American Chemical Society;* 109: No. 18, 5297-5303(2 Sep 1987).

Ab initiao molecular orbital calculations have been conducted on four tetrofuranose anomers, α- and β-D-erythrofuranose and α- and β-D-threofuranose, to study the effect of ring conformation on molecular parameters (bond lengths, bond angles, bond torsions) and on total energies. Geometric optimizations of envelope and planar conformers were conducted using the STO-3G basis set; single-point calculations were also performed with the 3-21G basis set. Preferred solution conformations deduced from previous NMR studies are in good agreement with those predicted by calculation, indicating that the intrinsic structures of these furanoses dictate their preferred geometries, and that solvation by water (^1H_2O) does not appear to be a major conformational determinant. The β-D-erythro configuration, which is structurally related to the β-D-ribo configuration found in RNA, was found to have significantly different conformational behavior from the other three configurations.

1368 **New route to trimethylsilylated spherosilicates: synthesis and structure of $[Si_{12}O_{18}](OSiMe_3)_{12}$, D/sub 3h/-$pSi_{14}O_{21}](OSiMe_3)^{14}$, and C/sub 2v/-$[Si_{14}O_{21}](OSiMe_3)_{14}$.** Agaskar, P.A.; Day, V.W.; Klemperer, W.G. (Univ. of Illinois, Urbana). *Journal of the American Chemical Society;* 109: No. 18, 5554-5556(2 Sep 1987). Contract AC02-76ER01198.

Molecular polyhedral silicates (spherosilicates) whose anionic oxygen atoms have been protected by trimethylsilyl groups are convenient molecular species for examining the properties of isolated polysilicate cage frameworks. At present, three such species are known: the trigonal prismatic $[Si_6O_9](OSiMe_3)_6$, cubic $[Si_8O_{12}](OSiMe_3)_8$, and pentagonal prismatic $[Si_{10}O_{15}](OSiMe_3)_{10}$ molecules. The family of trimethylsilylated spherosilicates ($Me_3SiOSiO_{1.5}$/)/sub n/ has been restricted to n = 6, 8, and 10 for purely practical reasons. These materials are prepared by trimethylsilylation of the silicate anions Si/sub n/O/sub 2.5n//sup n-/, and soluble anions are known only for n = 6, 8, and 10. The authors describe a new route to trimethylsilylated spherosilicates that utilizes hydridosiloxane precursors and report the synthesis, structure, and stability of three new compounds prepared by this route, $[Si_{12}O_{18}](OSiMe_3)_{12}$, D/sub 3h/-$[Si_{14}O_{21}](OSiMe_3)_{14}$, and C/sub 2v/-$[Si_{14}O_{21}](OSiMe_3)_{14}$.

1369 **Synthesis of boron nitride ceramics from poly(borazinylamine) precursors.** Narula, C.K.; Schaeffer, R.; Paine, R.T.; Datye, A.; Hammetter, W.F. (Univ. of New Mexico, Albuquerque). *Journal of the American Chemical Society;* 109: No. 18, 5556-5557(2 Sep 1987).

Several simple monomeric boron and nitrogen reagents have been utilized as starting materials in high-temperature pyrolyses or chemical vapor deposition schemes to prepare hexagonal boron nitride. However, extensive applications and demands for new forms (films, gels, foams, fibers) have recently led to searches for improved syntheses and processing techniques for BN. The authors preliminary studies indicate that an oligomeric borazinylamine gel can be prepared in high yield, and this gel provides a useful precursor for the formation of hexagonal boron nitride. It is also very important to note that this chemistry provides a system which is adaptable to sol-gel processing. Although several features require additional study, it is apparent that the amine cross-linking of borazene fragments offers a beneficial and important advance in the use of borazenes as sources for BN. It is interesting to note that some investigators have suggested that the presence of silica in boron nitride improves its processing characteristics as well as prevents hydrolysis of boron nitride. Therefore, the presence of organosilicon in their synthesis may prove beneficial. Additional studies of chemicall modified borazenes and other cross-linking reagents are in progress.

1370 **Solvent reorganization in optical and thermal electron-transfer processes: solvatochromism and intramolecular electron-transfer barriers in spheroidal molecules.** Brunschwig, B.S.; Ehrenson, S.; Sutin, N. (Brookhaven National Lab., Upton, NY). *Journal of Physical Chemistry;* 91: No. 18, 4714-4723(27 Aug 1987). Contract AC02-76CH00016.

Expressions for the shift of the absorption and emission band maxima of a solute with changes of the solvent's dielectric properties are presented for solute molecules with shapes and polarizabilities that can be approximated by those of spherical dielectric-continuum cavity. The derivations use a nonequilibrium thermodynamic approach developed by Marcus. An series of accurate approximations for the solvent shifts are presented. The new expressions are shown to reduce to equations previously derived by McRae, Ooshika, Mataga, and others when point-dipole approximations are made and particular values of the solute polarizability are assigned. The polarizability of the solute can be related to the internal dielectric constant of the cavity, and general expressions for the band shift in the point-dipole limit containing the dielectric constant of the cavity as a parameter are derived.

1371 **Solvent isotope effects on alkyltrimethylammonium bromide micelles as a function of alkyl chain length.** Berr, S.S. (Univ. of Virginia, Charlottesville). *Journal of Physical Chemistry;* 91: No. 18, 4760-4765(27 Aug 1987). Contract AC05-84OR21400.

The effect on micellar structure of changing the solvent from H_2O to D_2O for alkyltrimethylammonium bromide [C/sub n/TAB; C/sub n/TAB triple bond C/sub n/H/sub 2n+1/N$(CH_3)_3$Br, with n = 12, 14, and 16] has been examined. The energetics of micellization have been determined by measuring critical micelle concentrations by using surface tensiometry. The micellar structure has been elucidated through the use of small-angle neutron scattering (SANS). It was found that there is a solvent isotope effect that is small for C_{12}TAB but increases with n. This effect is manifested mainly by an increase in aggregation number and is attributed to solvent-hydrocarbon interactions of the dissolved monomers. The fractional charge of the micelle is not altered by the isotopic composition of the solvent. C/sub n/TAB micelles are found to be drier than are micelles formed by the corresponding sodium alkyl sulfates, and this results in a larger solvent effect for the quaternary ammonium bromides.

1372 **Metal dπ-ligand π conflicts in octahedral oxo, carbyne, and carbonyl complexes.** Brower, D.C.; Templeton, J.L.; Mingos, D.M.P. (Univ. of North Carolina, Chapel Hill). *Journal of the American Chemical Society;* **109**: No. 17, 5203-5208(19 Aug 1987).

Metal-ligand π interactions in group VI model compounds containing oxo, carbyne, and carbonyl ligands are probed with use of the extended Hueckel method. The interplay between M double bond O π bonding optimization and the metal σ framework geometry in $[MoO_2H_4]^{2-}$ is examined first. The importance of oxygen's electronegativity for housing lone pairs in monomers containing terminal oxygens is noted and later contrasted with similar model compounds containing carbyne ligands. Calculations on $[W(CH)_2H_4]^{+}$ confirm the qualitative expectation that a nonbonding carbon 2p orbital combination exists for both cis and trans isomers. Even though this orbital is not at particularly high energy for a filled frontier orbital, they anticipate that these carbyne carbons will be vary nucleophilic if filled or very electrophilic if vacant; i.e., they will resemble a carbanion or a carbonium ion. A mixed oxocarbyne complex, such as $[W(CH)(O)H_4]^{2-}$ will exhibit a dπ conflict with the covalency requirements of the carbyne causing electron density to build up on the terminal oxygen. Competition for dπ orbitals also results when π-acid ligands are trans to π-donor ligands. Recognition of π-acid/π-donor dπ conflicts rationalizes the cis geometry of W(O)(CO) in d^2 M(O)(CO)L_4 octahedra.

1373 **Division S-2-soil chemistry.** Jardine, P.M.; Zelazny, L.W. (Oak Ridge National Lab., TN). *Soil Science Society of America Journal;* **51**: No. 4, 885-889(Jul-Aug 1987). Contract AC02-83ER60170.

The kinetic reactions of ferron (8-hydroxy-7-iodo-5-quinoline-sulfonic acid) with unneutralized and partially neutralized Al solutions in the presence of various organic anions were investigated with the intent of distinguishing mononuclear and polynuclear Al. Mononuclear Al solutions containing malate, glutarate, succinate, salicylate, formate, malonate, and fulvate with ligand/Al molar ratios ranging from 0.4 to 7.5, reacted rapidly with ferron and were modeled using a single second-order equation. Mononuclear Al solutions containing citrate, tartarate, and oxalate with ligand/Al molar ratios $\leq$ 0.13, 0.08, and 0.38, respectively, also reacted rapidly with ferron and were modeled using a single second-order expression. Model fitted k/sub a/ values (rate of Al-monomer reactions with ferron) for these organic-Al solutions were similar to k/sub a/ values determined for mononuclear Al solutions without added organic ligands. Increasing concentrations of citrate, tartarate, and oxalate that cause the ligand/Al molar ratios to exceed the critical values of 0.13, 0.08, and 0.38, respectively, form complexes with Al that are not easily degraded by ferron, thus limiting the credibility of accurate distinction between monomeric and polymeric Al. The interaction of ferron with Al-polymers was not significantly affected by concentrations of organic anions whose ligand/Al molar ratio did not exceed these critical values. These conditions allowed the accurate distinction of mononuclear and polynuclear Al.

1374 **Influence of inorganic anions on the speciation of mononuclear and polynuclear aluminum by ferron.** Jardine, P.M.; Zelazny, L.W. (Oak Ridge National Lab., TN). *Soil Science Society of America Journal;* **51**: No. 4, 889-892(Jul-Aug 1987). Contract AS05-83ER60179.

The kinetic reactions of ferron (8-hydroxy-7-iodo-5-quinoline-sulfonic acid) with unneutralized and partially neutralized Al solutions in the presence of various inorganic anions were investigated for the purpose of differentiating mononuclear and polynuclear Al. Development of a general order reaction function indicated that ferron interactions with Al were modeled best by second-order rate expressions. Mononuclear Al solutions containing ClO_4^-, Cl^-, NO_3V, SO_4^{2-}, $H_2PO_4^-$, and F^- with anion to Al molar ratios of 13, 21, 15, 5, 0.75, and 0.08, respectively expressed similar reactions with ferron that conformed to a single second-order reaction. Ferron interactions with partially neutralized Al-anion solutions were described by two simultaneous second-order reactions that provided the rate of Al-polymer interactions with ferron, k/sub b/, and the mole fraction of mononuclear Al species present, f/sub a/. Distinction of mononuclear and polynuclear Al in partially neutralized solutions with various anions is possible using ferron if the $H_2PO_4^-$/Al and F^-/Al molar ratios do not exceed $\approx$ 0.75 and 0.08, respectively. Phosphate and F^- concentrations that reduce these ratios and SO_4^{2-}/Al ratios of $\approx$ 5 still form complexes with Al, but are easily degraded by ferron and react identically to uncomplexed mononuclear Al solutions. Such complexes must be accounted for if an estimate of toxic mononuclear Al [$Al(H_2O)_6^{3+}$, $AlOH(H_2O)_5^{2+}$, $Al(OH)_2(H_2O)_4^+$] is desired.

1375 **Potentiometric investigation of the hydrolysis of chromate(VI) ion in NaCl media to 175°C.** Palmer, D.A.; Wesolowski, D.; Mesmer, R.E. (Oak Ridge National Lab., TN). *Journal of Solution Chemistry;* **16**: No. 6, 443-463(Jun 1987). Contract AC05-84OR21400.

The hydrolysis of chromate ion was studied potentiometrically in a concentration cell fitted with hydrogen electrodes by titrating basic NaCl-Na_2CrO_4 solutions with standardized HCl against a NaOH reference solution. The temperature was varied from 25 to 175°C at 25° intervals at the following ionic strengths (I): 0.1140, 0.2346, 0.5337, 0.9988, 2.940, and 5.239 (NaCl). Depending on the ionic strength, the molality of total chromium was varied from 0.001 to 0.100. The resulting titration curves could be resolved best in terms of three equilibria involving the formation of $HCrO_4^-$ (aq), $Cr_2O_7^{2-}$ (aq), and CrO_3Cl^- (aq). The equilibrium quotients for all three reactions were fitted as a function of temperature and ionic strength, and the molal thermodynamic parameters that were computed from these relationships are tabulated at specific ionic strengths over the experimental temperature range.

1376 **Spectroelectrochemical study of magnesium electrolysis.** Yoon, S.Y.; Sadoway, D.R. (Dept. of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139). pp 851-860 of Light metals - 1987. Zabreznik, R.D. Warrendale, PA; The Metallurgical Society Inc. (1987). (CONF-870272—).

From American Institute of Metallurgical Engineers annual meeting: light metals session; Denver, CO, USA (22 Feb 1987).

The characteristics of laboratory sale magnesium electrolysis cells are being investigated by spectroscopic and electrochemical techniques. To determine the factors controlling the concentrations and spatial distributions of the various chemical species in the cell, Raman spectra are taken in situ, during electrolysis. The electrolyte consists of 11% MgCl/sub 2/, 65% NaCl, 18% KCl and 6% CaCl/sub 2/. Cells operate at a temperature of 750°C and current densities of up to 2 A cm/sup -2/. Recent results indicate that it is possible to monitor MgCl/sub 2/ concentration spectroscopically on-line in real time using CaCl/sub 2/ as a reference. Through cyclic voltammetry, which can also be performed in the same cell, valuable information about electrode kinetics and the existence of short-lived chemical species is being sought.

1377 **Simple molybdate selective oxidation catalysts containing excess MoO/sub 3/ for C/sub 4/ hydrocarbon oxidation to maleic anhydride.** Ozkan, U.; Schrader, G.L. (Ames Lab., USDOE, Ames, IA). pp A-15 of The ninth North American meeting of the Catalysis Society. Wilmington, DE; Catalysis Society (of North America) (1985). (CONF-8503251—).

From 9. North American meeting of the Catalysis Society; Houston, TX, USA (17 Mar 1985).

The selective oxidation of C/sub 4/ hydrocarbons to maleic anhydride over NiMoO/sub 4/ and CoMoO/sub 4/ catalysts containing excess MoO/sub 3/ was studied using a fixed bed, integral reactor system. The synthesis of pure phases and the techniques for incorporating excess MoO/sub 3/ have been investigated. Synthesis techniques included precipitation, solid state reaction, and impregnation. Extensive characterization of the catalyst has been performed using complementary instrumentation techniques, including laser Raman spectroscopy, Raman microprobe spectroscopy, x-ray diffraction, x-ray fluorescence, x-ray photoelectron spectroscopy, scanning electron microscopy, and energy dispersive x-ray analysis. Activity and selectivity measurements were performed for 1-butene, 1,3-butadiene, and furan oxidation. The most selective component of the catalyst for maleic anhydride production was determined to be a MoO/sub 3/ phase which possessed a surface covering of NiMoO/sub 4/. It was also found that both MoO/sub 3/ and NiMoO/sub 4/ had the highest selectivity for CO/sub x/ formation, but MoO/sub 3/ was much more active. MoO/sub 3/ was shown to possess separate catalytic sites capable of forming either CO/sub x/ or maleic anhydride. NiMoO/sub 4/ was found to serve a multifunctional role in the catalytic job distribution, including catalysis of the oxidative dehydrogenation of 1-butene to 1,3-butadiene and establishment of selectivity for maleic anhydride by selectively blocking complete oxidation sites on the MoO/sub 3/ surfaces.

1378 **Model V-P-O catalysts for n-butane oxidation to maleic anhydride.** Moser, T.P.; Schrader, G.L. (Dept. of Chemical Engineering and Ames Lab., USDOE, Ames, IA). pp A-1 of The ninth North American meeting of the Catalysis Society. Wilmington, DE; Catalysis Society (of North America) (1985). (CONF-8503251—).

From 9. North American meeting of the Catalysis Society; Houston, TX, USA (17 Mar 1985).

The selective oxidation of n-butane to maleic anhydride was examined using two model vanadium-phosphorus-oxide catalysts, β-VOPO/sub 4/ and (VO)/sub 2/P/sub 2/O/sub 7/. Both compounds were successfully prepared by solid state techniques; other methods, such as precipitation, generally produced impure phases. β-VOPO/sub 4/ was synthesized from NH/sub 4/H/sub 2/PO/sub 4/ and V/sub 2/O/sub 5/ which were calcined in dry oxygen at 600°C and then cooled at a rate no greater than 40°C/h. (VO)/sub 2/P/sub 2/O/sub 7/ was also prepared from NH/sub 4/H/sub 2/PO/sub 4/ and V/sub 2/O/sub 5/ which was heated to 400°C in O/sub 2/ and then nitrogen; the temperature was raised to 760°, followed by cooling at 50°C/h in nitrogen.

1379 **Raman spectroscopic investigation of the effect of H/sub 2/O and NiO on the surface structure of NiO-MoO/sub 3//Al/sub 2/O/sub 3/.** Makovsky, L.E.; Stencel, J.M.; Diehl, J.R.; Sarkus, T.A.; Paterline, J.F. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). pp P-9 of The ninth North American meeting of the Catalysis Society. Wilmington, DE; Catalysis Society (of North America) (1985). (CONF-8503251—).

From 9. North American meeting of the Catalysis Society; Houston, TX, USA (17 Mar 1985).

Raman spectroscopic and ion scattering spectrometry (ISS) data is presented on (0-7)% NiO-15% MoO/sub 3//Al/sub 2/O/sub 3/ and (0-4)% NiO-7.5% MoO/sub 3//Al/sub 2/O/sub 3/. Both sets of catalysts were prepared with a Harshaw Al-4104 α-Al/sub 2/O/sub 3/. The surface areas of the support and the catalysts were approximately 200 m/sup 2//g. Molecular speciation of the two sets of catalysts were analyzed as a function of in-situ O/sub 2/ calcination and H/sub 2/O exposure by Raman spectroscopy and ISS. The incorporation of nickel into MoO/sub 3//Al/sub 2/O/sub 3/ is shown to perturb the spectral characteristics of the Raman active Mo = O stretching vibration. Such perturbations are discussed in relation to the structural characteristics of the catalysts. In addition, the effect of nickel on these structural properties is shown by in-situ Raman and ISS techniques to be different than the effect of H/sub 2/O. These differences are used to discuss interaction mechanisms and/or sites of interaction of Ni and H/sub 2/O with the molybdenum-oxygen units. Consequences of the molecular speciation on these oxide catalysts with relation to sulfidation and catalytic activity are discussed.

1380 **Hydrogen spillover from ruthenium to copper in Cu/Ru catalysts: A source of error in active metal titration.** Goodman, D.W.; Peden, C.H.F. (Surface Science Div., Sandia National Labs., Albuquerque, NM 87185). pp C-38 of The ninth North American meeting of the Catalysis Society. Wilmington, DE; Catalysis Society (of North America) (1985). (CONF-8503251—). Contract AC04-76DP00789.

From 9. North American meeting of the Catalysis Society; Houston, TX, USA (17 Mar 1985).

Bimetallic catalysts have been extensively studied because of their commercial and fundamental scientific importance. Chemisorption methods have been widely used to obtain information on the surface composition of these alloys and exclusively employed to define the absolute number of active metal atoms exposed, a number critical to absolute rate determinations. The assumptions of these methods are that only the catalytically active metal will dissociate molecular hydrogen and that the active metal, in turn, will adsorb approximately one hydrogen per surface metal atom. Of critical importance to the accuracy of chemisorption methods for active metal titration is that no significant spillover of the chemisorbed species occurs from the active to the inactive component. The authors report here that such spillover does occur in a Cu/Ru bimetallic system from the active ruthenium to the inactive copper.

1381 **VUV spectroscopy of rare-gas Van der Waals dimers.** Dehmer, P.M.; Pratt, S.T. pp 467-513 of Photophysics and photochemistry in the vacuum ultraviolet. McGlynn, S.P. (ed.). Amsterdam, Netherlands; D. Reidel Publishing Company (1985).

Results of a systematic study of the photoionization spectra of the homonuclear rare-gas dimers are presented. From the results for Ar_2, Kr_2, Xe_2, NeAr, NeKr, NeXe, ArKr, ArXe, and KrXe, a better understanding of the bonding in the Rydberg states and ions of these molecules is developed. Information is provided on both the excited states of the neutral dimers and on the ground and excited states of the dimer ions. A nearly complete list of ground-state dissociation energies for the homonuclear and heteronuclear rare-gas dimer ions has been compiled and is included. 45 references, 17 figures, 10 tables.

1382 **Spectral and kinetic properties of the products resulting from reactions of HO_2/O_2^- with manganese (II) complexes.** Bielski, B.H.J.; Arudi, R.L.; Cabelli, D.E. (Brookhaven National Lab., Upton, NY). pp 1-15 of Oxygen radicals in chemistry and biology. Bors, W.; Tait, S.D. (eds.). New York, NY; Walter de Gruyter & Company (1984).

A comparison of the reactivities of HO_2/O_2^-, MnO_3^+/$MnOOOH^{++}$ and Mn^{+++}-pyrophosphate toward some compounds of biological interest is presented here. The results of this study confirm earlier findings that HO_2/O_2^- form the relatively short-lived transient complexes $MnO_2/MnOOOH^{++}$ in reaction with weakly complexed Mn^{++}, while in the presence of strong complexing ligands like pyrophosphate, the desired endproducts are Mn(III)-complexes. 29 references, 2 figures, 8 tables.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 938, 1177, 1376, 1391

1383 **In situ surface extended x-ray absorption fine structure spectroscopy of a lead monolayer at a silver(111) electrode/electrolyte interface.** Samant, M.G.; Borges, G.L.; Gordon J.G. II; Melroy, O.R.; Blum, L. (IBM, San Jose, CA). *Journal of the American Chemical Society;* **109**: No. 20, 5970-5974(30 Sep 1987).

With use of fluorescence detection and grazing incidence excitation, the X-ray absorption spectrum was obtained, at the PbL/sub III/ edge, of a monoatomic adlayer of lead on a silver (111) electrode immersed in solution. The adlayer was produced by under potential deposition from aqueous lead acetate/sodium acetate electrolyte. The edge position and the near-edge structure confirm that the lead is fully reduced to the zerovalent state. The extended X-ray absorption fine structure (EXAFS) contains no detectable contribution from lead-silver scattering, either because the

lead layer is incommensurate with the underlying silver lattice or because there is large thermal motion of the lead atoms. Instead, the fine structure is due to scattering from a single type of light atom, most likely oxygen. This oxygen must arise from adsorbed water molecules or acetate ions. The lead-oxygen distance changes with the electrode potential from 2.33 +/- 0.02 A at -0.53 V to 2.38 +/- 0.02 A at -1 V (vs. Ag/AgCl, 3 M KCl).

1384 **Direct current conductivity study of geminate ions produced by photoionization in several alkane liquids. Comparison with Monte Carlo calculations.** Sauer, M.C. Mr.; Schmidt, K.H.; Liu, A. (Argonne National Lab., IL). *Journal of Physical Chemistry;* **91**: No. 18, 4836-4839(27 Aug 1987). Contract W-31-109-ENG-38.

The conductivity induced by absorption of 7-8-ns pulses of 248-nm light in several alkane liquids containing anthracene and an electron scavenger has been measured with time resolution of about 2 ns. As was previously observed in the case of cyclohexane, light absorbed by anthracene can also lead to ionization of trans-decalin. This results in a relatively large conductivity signal due to a positive ion of trans-decalin, which has previously been observed to have a high mobility when created by radiolysis. In several alkanes that do not show high-mobility solvent ions, the authors have measured the conductivity signal due to geminate ions relative to the signal due to free ions. These experimental results have been compared with the results of a stochastic model in the case of n-decane and isooctane. Good agreement is obtained with a Gaussian distribution of the separation distances within the geminate ion pairs at the end of the scavenging process. No agreement is obtained with an exponential distribution.

4005 Photochemistry

REFER ALSO TO CITATION(S) 477, 1358, 1361, 1384, 1391, 1398, 1467, 1478, 1742, 2101

1385 **(N—87-26173, pp vp) Experimental Resonance Enhanced Multiphoton Ionization (REMPI) studies of small molecules.** Dehmer, J.L.; Dehmer, P.M.; Pratt, S.T.; Ohalloran, M.A.; Tomkins, F.S. Jun 1987. NTIS, PC A09/MF A01. (NASA-CR—181163; JPL—87-14; NAS—1.26:181163; CONF-8611131—).

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

Resonance enhanced multiphoton ionization (REMPI) utilizes tunable dye lasers to ionize an atom or molecule by first preparing an excited state by multiphoton absorption and then ionizing that state before it can decay. This process is highly selective with respect to both the initial and resonant intermediate states of the target, and it can be extremely sensitive. In addition, the products of the REMPI process can be detected as needed by analyzing the resulting electrons, ions, fluorescence, or by additional REMPI. This points to a number of exciting opportunities for both basic and applied science. On the applied side, REMPI has great potential as an ultrasensitive, highly selective detector for trace, reactive, or transient species. On the basic side, REMPI affords an unprecedented means of exploring excited state physics and chemistry at the quantum-state-specific level. An overview of current studies of excited molecular states is given to illustrate the principles and prospects of REMPI.

1386 **Photophysics of chromium(III)-polypyridyl complexes. Effect of pH and]Cl$^-$]on the lifetimes of the $^2T^1/^2E$ excited states.** Neshvad, G.; Hoffman, M.Z.; Bolte, M.; Sriram, R.; Serpone, N. (Boston Univ., MA). *Inorganic Chemistry;* **26**: No. 18, 2984-2988(9 Sep 1987).

The lifetimes of the lowest doublet excited states ($^2T_1/^2E$) of tris(polypyridyl) complexes of Cr(III) ($Cr(NN)_3^{3+}$) have been measured in deoxygenated dilute aqueous solution as a function of pH at 5 °C. At pH 3-4, tau/sub obsd/, is significantly longer than at pH 9-10; tau/sub obsd/ and the intensity of luminescence from $^2T_1/^2E$ exhibit parallel pH functionality with an inflection point at pH ~6-7. For example, for $Cr(phen)_3^{3+}$, tau/sub obsd/ = 1.1 ms at pH 2 and 0.65 ms at pH 10; the activation energies of tau/sub obsd/, measured at 5-35 °C, are 37 kJ mol^{-1} at pH 3-4 and 31 kJ mol^{-1} at pH 9-10. The results are interpreted in terms of the existence of H_2O or OH^- within the intraligand pockets of $^2T_1/^2E$ due to the deep hydration of the long-lived, highly charged cation, with the rate of the nonradiative decay of $^2T_1/^2E$ reflecting the environment in the vicinity of the metal center. A mechanism for a relatively minor photochemical decay path is suggested. In the presence of 1 M NaCl, the magnitude of the pH effect is greatly diminished; for example for $Cr(phen)_3^{3+}$, tau/sub obsd/ = 0.62 and 0.61 ms at pH 3.3 and 9.5, respectively. In acidic solution, tau/sub obsd/ is a functional of [Cl^-]; for example, for $Cr(3,4,7,8\text{-}Me_2phen)_3^{3+}$ at pH 3.3, tau/sub obsd/ranges between 1.7 and 0.64 ms in 0.001 and 1 M Cl^-, respectively. The existence of Cl^- within the intraligand pockets of $^2T_1/^2E$ and, by extension, $^4A_2$, is also suggested. 42 references, 4 figures, 1 table.

1387 **Removal rate constant measurements for CH_3O by O_2 over the 298-973 K range.** Wantuck, P.J.; Oldenborg, R.C.; Baughcum, S.L.; Winn, K.R. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **91**: No. 18, 4653-4655(27 Aug 1987).

Removal rate constants for CH_3O by O_2 were measured over the temperature range 298-973 K by using a laser photolysis/laser-induced fluorescence technique. The removal rate constant shows a distant non-Arrhenius behavior suggesting that other removal processes, in addition to reaction, are important at higher temperature.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 365, 1383, 1397

1388 **(CEA-CONF—8979) Insatured polymeric thin film formation by energetic ions irradiations of fluoropolymers.** Le Moel, A.; Duraud, J.P.; Balanzat, E.; Darnez, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Mar 1987. 8p. (CONF-8703154—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752771/JAW.

From International symposium on trends and new applications in thin films; Strasbourg, France (16 Mar 1987).

This work deals with the study of both structural and electronic modifications of polyvinyldene fluoride (PVDF) by monochromatised X-ray photoemission spectroscopy (XPS). Monochromatised XPS has been used to follow the surface modifications of PVDF samples subjected to various levels of irradiations (oxygen ions: 800 MeV, krypton ions: 3600 MeV). Desorption of hydrogen fluoride molecules and the creation of cumulene compounds are observed. 46 refs.

1389 **(INP—1225/PS) Molecular crystals 83. Cracow, 5-8 September 1983. Proceedings of the conference. Vol. 1.** (Institute of Nuclear Physics, Krakow (Poland)). 1983. vp. (CONF-8309398—Vol.1). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87780100/JAW.

From Molecular crystals '83; Cracow, Poland (5 Sep 1983).

A conference is presented on molecular crystals. One item from it was selected for the Energy Data Base.

1390 **(N—87-25830) Production of O(1D) from dissociative recombination of $O_2(+)$.** Guberman, S.L. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA (USA)). 1987. 23p. (NASA-CR—191145; NAS—1.26:191145). NTIS, PC A02/MF A01.

The results of large scale ab initio calculations of the rates for production of O(1D) by dissociative combination of O2(+) are presented for electron temperatures in the range 100 to 3000 K. A 1-delta-u state is the dominant dissociative route from v = 0 and a 3-sigma-u(-) state is the most important route from v = 1 and v = 2. The calculated total rate for O(1D) production from v = 0 is 2.21(+0.21,-0.24) x 10(-7) x (T sub e/300) exp -.46 near room temperature. The v = 1 and v = 2 rates are about 17% and 47% smaller respectively, than the v = 0 rate at 300 K.

1391 **Pulse radiolytic and electrochemical investigations of intramolecular electron transfer in carotenoporphyrins and carotenoporphyrin-quinone triads.** Land, E.J.; Lexa, D.; Bensasson, R.V.; Gust, D.; Moore, T.A. Moore, A.L.; Liddell, P.A.; Nemeth, G.A. (Paterson Institute of Cancer Research, Manchester, England). *Journal of Physical Chemistry;* **91**: No. 18, 4831-4835(27 Aug 1987). Contract FG02-84CH10198.

Thermodynamic and kinetic aspects of intramolecular electron-transfer reactions in carotenoporphyrin dyads and carotenoid-porphyrin-quinone triads have been studied by using pulse radiolysis and cyclic voltammetry. Rapid (<1 μs) electron transfer from carotenoid radical anions to attached porphyrins has been inferred. Carotenoid cations, on the other hand, do not readily accept electrons from attached porphyrins or pyropheophorbides. Electrochemical studies provide the thermodynamic basis for these observations and also allow estimation of the energetics of photoinitiated two-step electron transfer and two-step charge recombination in triad models for photosynthetic charge separation.

1392 **Optical and thermal electron transfer in rigid difunctional molecules of fixed distance and orientation.** Penfield, K.W.; Miller, J.R.; Paddon-Row, M.N.; Cotsaris, E.; Oliver, A.M.; Hush, N.S. (Argonne National Lab., IL). *Journal of the American Chemical Society;* **109**: No. 17, 5061-5065(19 Aug 1987). Contract W-31-109-ENG-38.

Pulse radiolysis has been used to investigate intramolecular electron transfer in a series of molecules in which dimethoxynaphthalene (M_2N) and dicyanovinyl (DCV) groups are held at fixed distance and orientation by rigid saturated hydrocarbon bridges. Electron transfer from M_2N^- to DCV is faster than 1×10^9 s^{-1} for compounds in which the two groups are separated by 4, 6, 8, 10, or 12 saturated carbon-carbon bonds. For the 4-, 6-, and 8-bond compounds, optical electron transfer bands are present in the visible - near-infrared absorption spectra of the anions. The positions shift to higher energies with increasing solvent polarity. Their intensities are large (epsilon $\approx$ 2000 M^{-1} cm^{-1} for the 4-bond compound) and decrease rapidly as the length of the bridge increases. It is clear that exceptionally large, long-distance electronic coupling of the two π systems occurs through the saturated bonds of the bridge. These electronic couplings are 0.16, 0.06, and 0.03 eV across 4-, 6-, and 8-bond bridges. Even larger couplings have been observed previously by photoelectron spectroscopy, but not for such large π systems. With these large electronic couplings, long-distance electron transfer in the 4- and 6-bond compounds is expected to be adiabatic. Even for the 8-bond compound with a center-to-center distance of ~12 A the electron-transfer rate reduced from the optical electron-transfer absorption band is $> 10^{12}$ s^{-1}.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 1299, 1755

1393 **(AD-A—183332/6/XAB) Synthesis of radiolabeled mycotoxins. Final report, 1 December 1984-30 November 1986.** Kraus, G.A. (Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Chemistry). 1 Jun 1987. 5p. NTIS, PC A02/MF A01.

The synthesis of labelled mycotoxins by chemical modification of readily available simpler mycotoxins was shown to be feasible. T-2 tetraol and T-2 tetraacetate with three deuterium atoms attached to the carbon skeleton were prepared. These compounds will be used in mass spectroscopy to pinpoint fragmentations of their nondueterated counterparts.

1394 **(CONF-8606111—Absts.) Sixth international symposium on radiopharmaceutical chemistry: Abstracts: Final report.** (Harvard Univ., Cambridge, MA (USA); Massachusetts Inst. of Tech., Cambridge (USA)). 1986. Contract FG02-86ER60458. 438p. NTIS, PC A19. Order Number DE87014121/JAW.

From 6. international symposium on radiopharmaceutical chemistry; Boston, MA, USA (29 Jun 1986).

The 113 abstracts are arranged under the following section headings: alkyl spiperone derivatives labeled with fluorine, synthesis of compounds labeled with positron emitters, technetium compounds, positron emitters (target design and synthesis), indium and gallium, halogens, labeled proteins and antibodies, radiopharmaceuticals for brain and SPECT, general, and receptor radioligands.

1395 **(CRN-CPR—85-11) Chemical effects associated to (n, γ) nuclear reactions in diluted aqueous solutions of liquid or frozen organic halogenides.** Bermudez Rodriguez, I.M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Sep 1985. 82p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87752686/JAW.

Chemical effects associated to nuclear transformation /sup 37/Cl (n, γ) /sup 38/Cl or /sup 127/I (n, γ) /sup 128/I in solid or liquid aqueous solutions of ethyl iodide, trichloro-ethylene, thyroxine or DDT irradiated in a nuclear reactor are studied. The retention of radiohalogen under its initial chemical shape decrease with solute concentration in liquid phase but is almost constant with solute dilution in the solid phase. Potential applications in neutron activation analysis evidencing halogenated molecules in irradiated media are discussed. 57 refs.

1396 **(IPNO-T—86-03) Contribution to the study of fluoride and oxyfluoride elements 4d, 5d and 5f by thermochromatography.** Fargeas, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 120p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87752730/JAW.

The results exposed in this report constitute an extension of works effected in laboratory of Radiochemistry, on the thermochromatography. They confirm the validity of this method as way to identify oxidation states of element. In a first time experimental results realised in fluorined atmosphere on Tc, Re, Os, Mo and Ir by thermochromatography, have enable to extend the identification scope right to seven valency. This results applied to actinides and especially to neptunium and plutonium have given rise to identification for the first time, in gas phase, the next compounds: PuO/sub 2/F/sub 3/, PuOF/sub 5/, NpO/sub 3/F, NpO/sub /2F/sub 3/, NpOF/sub 5/, NpF/sub 7/ and the confirmation to PuO/sub 3/F. Moreover the adsorption heat of UF/sub 4/, UF/sub 6/ and IrOF/sub 4/ has been determined. The adsorbent surface has been studied by Electron Spectroscopy for Chemical Analysis (ESCA), it is an homogeneous layer of NiF/sub 2/ along the thermochromatograph. The valency 6 of the molybdene has been confirmed on the compound identified by thermochromatography as MoOF/sub 4/. The theoretical model of adsorption founded on a chimisorption process between one fluorined or oxyfluorined Ru molecules and one then two NiF/sub /2 molecules, allow to make out lineares correlations between the complex adsorbent-adsorbat energezing gain of formation and the characteristic deposition temperature, significant of the compound and the element valency.

1397 **(RCM—00187) Chemical behaviour of Np, Pu and Am in saline solutions: Radiolysis, solubility, hydrolysis, chloride complexation and speciation.** Kim, J.I.; Apostolidis, C.; Bueppelmann, K.; Kanellakopulos, B.; Klenze, R.; Lierse, C.; Magirius, S. (Technische Univ. Muenchen, Garching (Germany, F.R.). Lehrstuhl fuer Radiochemie). Jan 1987. 59p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753304/JAW.

The assessment of the migration behaviour of actinide elements (Np, Pu, Am) in the geosphere requires detailed knowledge on basic geochemical reactions, which include not only primary reactions of actinides with groundwater components but also secondary reactions, such as radiolysis, redox reaction, colloid formation, etc. The radiolytic behaviour of Pu and Am has been investigated in solutions of high NaCl concentration, in which radiolysis reactions are induced by intensive α-radiations of actinides themselves. An increase in the redox potential (Eh) is observed in solutions, which results in the quantitative oxidation of Pu(IV) into Pu(VI) and Am(III) into Am(V). These reactions are dependent on pH, salinity and specific α-activity. The results of α-radiolysis are compared with the effect of γ-radiolysis on inactive chloride solutions. As Pu(VI) can be stabilized in concentrated NaCl solutions, indicating that chloride complexation of Pu(VI) is important, the chloride

complexation is studied by spectrophotometry and the stability constants of the first two Pu(VI)-chloro complexes are determined. Solubility experiments of NpO/sub 2/ and NpO/sub 2/OH in concentrated saline solutions are carried out under aerobic and anaerobic atmosphere (90% Ar, 1% CO/sub 2/). The speciation of soluble species is undertaken by UV-VIS-spectrophotometry. The experiment of the Am(III)-hydrolysis reaction has revealed a dependence of Am solubility on the specific α-activity. However, no alteration in the chemical state of hydrolysis products is observed in different specific α-activities. The speciation is carried out by laser induced photoacoustic spectroscopy (LPAS) because of the low Am(III) solubility at pH>7.

1398 **Reaction of fluorine atoms with monomeric and polymeric uranium pentafluoride.** Lyman, J.L.; Holland, R. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **91**: No. 18, 4821-4826(27 Aug 1987).

The authors have measured the room-temperature rate constants for formation of UF_6 from the reaction of fluorine atoms with UF_5. The rapid growth of UF_5 clusters (polymers) from the nascent monomeric species complicates the rate measurements. The ratio of the rate of UF_5-dimer formation to the rate of monomer-fluorine recombination is insensitive to the cluster formation. That ratio, k/sub mm//k/sub rm/ = 5.0 +/- 1.0, is the authors most reliable experimental result. It, along with additional experimental data, give k/sub rm/ = 8.0 x 10^{-13} cm^3 $molecule^{-1}$ s^{-1} and k/sub mm/ = 4.0 x 10^{-11} cm^3 $molecule^{-1}$ s^{-1}. To obtain the dependence of reaction rates on s, the average UF_5 polymer size, the authors assumed that the rates were proportional to the collision rate. The derived rate constants were k/sub pp/ = k/sub mm/s/sup 1/6/ cm^3 $molecule^{-1}$ s^{-1} for cluster growth and k/sub rp/ = 4.1 x $10^{-14}(1 + 2a/sup 1/3/)^2$ cm^3 $molecule^{-1}$ s^{-1} for reaction of fluorine atoms with polymeric UF_5. The experimental procedure was to photolyze both F_2 and UF_6 in helium diluent with a KrF excimer laser to produce UF_5 and an excess of fluorine atoms. This allowed the slower recombination reactions to compete with polymerization. They monitored the transient concentration of UF_6 with an ultraviolet probe beam at 215 nm. The recombination of fluorine atoms with UF_5 monomer is substantially faster than recombination with the polymer.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

1399 **(N—87-26303) Diffusion-controlled reaction in a vortex field.** Rehm, R.G.; Baum, H.R.; Lozier, D.W. (National Bureau of Standards, Washington, DC (USA)). Jun 1987. 37p. (NBSIR—87-3572). NTIS, PC A03/MF A01.

A two dimensional model of a constant density diffusion controlled reaction between unmixed species initially occupying adjacent half-spaces is formulated and analyzed. An axisymmetric viscous vortex field satisfying the Navier-Stokes equations winds up the interface between the species as they diffuse together and react. A flame sheet approximation of the rapid reaction is made using Shvab-Zeldovich dependent variables. The model was originally proposed by F. Marble, who performed a local analysis and determined the total consumption rate along with the flame sheet. A global similarity solution to the problem is described which is Fourier analyzed in a Lagrangian coordinate system. An asymptotic analysis of the Fourier amplitudes, valid for large Schmidt numbers is presented. The solution is evaluated numerically in Lagrangian and Eulerian coordinate systems. This problem was studied as part of a more general model which has application to the description of turbulent combustion.

1400 **Mixing of cryogenic fluids and predicted detonation properties for multiphase liquid oxygen and liquid hydrogen.** Bishop, C.V.; Benz, F.J.; Ullian, L.J. Las Cruces, NM; National Aeronautics and Space Administration (1986). 13p. NTIS, PC A25/MF A01.

The mixing and explosion of LOX and LH_2 is a concern for Space Transportation System operations. To understand this problem, cryogenic mixing is experimentally studied by pouring 1,2,2 trichloro 2,1,1 trifluoroethane (Freon 113) into LN_2, LN_2 into LH_2, and LH_2 into into LN_2 in a 1 m by 15 cm cylindrical glass vessel. Data from these experiments is compared with previous studies and a hypothesis is advanced that LOX/LH_2 mixing will result in a complex, heterogenous, multiphase aggregation including LOX, SOX, LH_2, and VH_2 using the multiphase hypothesis. Visual and x ray observations of the process and mass measurements are reported.

42 ENGINEERING

REFER ALSO TO CITATION(S) 611

1401 **(N—87-25884) National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, volume 2.** Mcinnis, B.; Goldstein, S. (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). Jun 1987. 286p. (NASA-CR—171984-VOL-2; NAS—1.26:171984-VOL-2). NTIS, PC A13/MF A01.

The Johnson Space Center (JSC) NASA/ASEE Summer Faculty Fellowship Program was conducted by the University of Houston and JSC. The ten week program was operated under the auspices of the American Society for Engineering Education (ASEE). The basic objectives of the program are (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate an exchange of ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of participants' institutions; and (4) to contribute to the research objectives of the NASA Centers. Each faculty fellow spent ten weeks at JSC engaged in a research project commensurate with his interests and background and worked in collaboration with a NASA/JSC colleague. The final reports on the research projects are presented. This volume, 2, contains sections 15 through 30.

1402 **(N—87-26692) National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, Volume 1.** Mcinnis, B.; Goldstein, S. (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). Jun 1987. 358p. (NASA-CR—171984-VOL-1; NAS—1.26:171984-VOL-1). NTIS, PC A16/MF A01.

The Johnson Space Center (JSC) NASA/ASEE Summer Faculty Fellowship Program was conducted by the University of Houston. The basic objectives of the program are: (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate an exchange of ideas between participants and NASA; (3) to enrich and refresh the research and teaching objectives of participants' institutions; and (4) to contribute to the research objectives of the NASA Centers. Each faculty fellow spent ten weeks at JSC engaged in a research project commensurate with his interests and background and worked in collaboration with a NASA/JSC colleague. Volume 1 contains sections 1 through 14.

1403 **(UCRL—97460) Long term orbital stationkeeping using low amplitude harmonic thrust.** Morgan, T. (Lawrence Livermore National Lab., CA (USA)). 5 Oct 1987. Contract W-7405-ENG-48. 9p. (CONF-8710122—2). NTIS, PC A02. Order Number DE88000421/JAW.

From 38. congress of the International Astronautical Federation; Brighton, UK (10 Oct 1987).

The earth's geopotential creates perturbations to a satellites orbit which complicate long term stationkeeping if highly precise elliptical orbits are required. In missions of extreme duration the propellant overhead required to correct these effects by impulsive maneuvers motivates the search for more efficient alternatives. For certain conditions some savings can be realized by prescribing an harmonic thrust program. 5 refs., 4 figs.

1404 **(RFP-Trans—470) Technique of length measurement by laser interferometry.** Schuessler, H.H. Translated from *Technisches Messen ATM ;* **52**: No. 6, 225-232(1985). 19p. NTIS, PC A02/MF A01. Order Number DE87013731/JAW.

The high level of laser interferometry for length measurements has led to its wide application in accuracy tests of machine tools and measuring machines, in calibration procedures and in research and development. Design features and requirements of a system are described. Numerous individual special arrangements can be realized by variation and combination of the optical components. Unresolved problems resp. wishes of the users are connected with the compensation system, built-in transducer system in machines and with the development of light and small semiconductor lasers for interferometry. The accuracy test of the laser-interferometer itself is of increasing interest for the user. This paper discusses the technique, accuracy, design, and application of laser interferometry systems.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 212, 270, 277, 278, 280, 281, 283, 395, 1060, 1070, 1080, 1160, 1207, 1276, 1447, 1480, 1654, 2593, 2603, 2612, 2736

1405 **(AD-A—183057/9/XAB) Experimental and analytical development of a sensitive superconducting accelerometer and gravity gradiometer. Final report, 1 November 1984-30 October 1985.** Fairbank, W.M. (Stanford Univ., CA (USA). Dept. of Physics). 30 Oct 1985. 61p. NTIS, PC A04/MF A01.

A previously developed gravity gradiometer was further developed to become a very-sensitive gravitational gradiometer. A passive subtraction of the thermal sensitivity can be accomplished at low frequencies. This subtraction can be extended to higher frequencies by coupling the temperature-sensing coil more tightly in temperature to the gradient-sensing coil. This could be accomplished by mounting the temperature sensing coil to the inside surface of the gradient-sensing coil form.

1406 **(BDX—613-3806) Increased robotic capabilities for lead preparation and component insertion on printed wiring assemblies: Topical report.** Groot, K.J. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Sep 1987. Contract AC04-76DP00613. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000136/JAW.

Printed Wiring Assembly (PWA) Robotics development work has increased the capabilities of the robotic component preparation (RCP) workcell to include a mechanism to trim and preform component leads, a part feeder system for radial-leaded components (capacitors and transistors), a fixture to orient axial-lead component marking, the use of dummy parts to separate the component types in the RCP carousel, and the use of the RCP controller to automatically keep track of the quantities of components loaded into the RCP carousel. These changes have reduced the amount of standard hours required to process the components for printed wiring assemblies (PWAs) with a resulting significant cost savings. An order for robotic component insertion system (RCIS) was released for purchase in May 1986 and is scheduled to be shipped to Bendix Kansas City Division (BKC) in the third quarter FY87. An interface system was designed to automate the storage and handling of components between the RCP and RCIS in order to reduce the amount of production operator intervention.

1407 **(CONF-870970—4) UNISOR on-line nuclear orientation facility.** Girit, I.C.; Alton, G.D.; Bingham, C.R.; Carter, H.K.; Simpson, M.L.; Cole, J.D.; Hamilton, J.H.; Kern, B.D.; Krane, K.S.; Zganjar, E.F. (Vanderbilt Univ., Nashville, TN (USA); Joint Inst. for Heavy Ion Research, Oak Ridge, TN (USA); Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA); Oak Ridge Associated Universities, Inc., TN (USA); EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014937/JAW.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

The UNISOR on-line nuclear orientation facility consists of a He_3-He_4 dilution refrigerator on line to the isotope separator. Nuclei are implanted directly onto a target foil soldered to the bottom accessed cold finger of the refrigerator. A 1.5 T superconducting magnet polarizes the ferromagnetic target foils and determines the axis of symmetry. Up to eight gamma detectors can be positioned around the refrigerator, each 9 cm from the target. A unique feature of this system is that the $k = 4$ term in the directional distribution function can be deduced so that a single solution for the mixing ratio can be found.

1408 **(CONF-871007—9) Computer-aided x-ray image system design and evaluation.** Ciarcia, C.A.; Rupp, T.D. (EG and G Energy Measurements, Inc., Los Alamos, NM (USA)). 1987. Contract AC08-83NV10282. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000997/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A comprehensive, integrated computer code structured to provide assistance during the design, optimization, fielding, and data reduction stages of an x-ray image test diagnostic will be presented. This three-dimensional x-ray transport and imaging model is designed to simulate the spatial distribution, resolution and radiance profile of a two-dimensional x-ray image displayed at the scintillation plane or the optical imaging plane of a coupled transfer system. Direct ray-trace and fast Fourier transform techniques are used to incorporate the response functions of each system component into the model.

1409 **(CORR—86-00241) Static standing and dynamic walking of a practical biped robot.** Zheng, Yuan F.; Rao, M. (Clemson Univ., SC (USA). Dept. of Electrical and Computer Engineering). [1987]. Contract AC09-76SR00001. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001367/JAW.

The study of static standing and dynamic walking of a practical biped robot is presented in this research report. A systematic method for describing the kinematic behavior of a biped robot is first developed. The development is based on the well-known Denavit-Hartenburg convention. As a result, the method is basically the same as the one used for robot manipulators, except for some considerations given to the unique functions and structure of a biped robot. The static standing of a biped robot is then studied. It is argued that static standing capability is very important if a biped robot is to be employed in an industrial environment. In order to measure the performance of the biped in static standing in terms of its stability, two parameters, stable margin and stable index, are introduced. Based on these parameters, optimal stability of the biped robot with one-foot and two-foot standing cases are discussed. For dynamic walking, a mathematical treatment is first described. Conclusion is reached that by proper positioning of the landing, stable dynamic walking can be realized. A practical biped robot is introduced in the final part of the report. Experimental results of static standing and dynamic walking of the biped robot are presented, to verify the theoretical results. 28 refs., 9 figs., 1 tab.

1410 **(DOE/CE/15334—T1) Non-contacting fluid ring seal systems for railcar axle bearing systems: Quarterly progress report No. 1, June 15 to September 15, 1987.** (Ernst Mechanical Industries, Old Saybrook, CT (USA)). 1987. Contract FG01-87CE15334. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014556/JAW.

The main objectives of this DOE contract is the technical development of a practical, cost effective Fluid Ring seal system capable of: Drastically reducing locomotive drawbar traction power requirements by lowering seal friction losses prevalent in present railcar axle bearing systems; increasing reliability and safety of railroad cars by minimizing bearing lubricant leakage and minimizing bearing "hot boxes"; and improving the productivity of the railway transportation systems by reducing rolling stock "outages" due to long seal life. 14 refs.

1411 **(DOE/ER/10938—5) Hierarchical procedures for flowsheet, control system and retrofit design for chemical processes: Final report for the period August 1, 1981 to January 31, 1987.** Douglas, J.M.; Malone, M.F. (Massachusetts Univ., Amherst (USA). Dept. of Chemical Engineering). Aug 1987. Contract AC02-81ER10938. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014093/JAW.

A systematic procedure for the design of chemical process flowsheets, control systems and retrofits is described. The approach is based on a combination of heuristics along with short-cut design and economic models that can be implemented on a minicomputer. The procedure provides a rapid means for selecting the process units and the interconnections between these units, generates a list of alternatives for these selections, identifies the dominant design variables for each alternative design, estimates the optimum design conditions for each case, and screens the various alternatives. By using short-cut methods for the calculations, a complete design can be evaluated in about 10 seconds on a minicomputer and alternatives can be screened very rapidly.

1412 **(DP-MS—87-6) Expert robots in nuclear plants.** Byrd, J.S.; Fisher, J.J.; DeVries, K.R.; Martin, T.P. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 11p. (CONF-870832—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014839/JAW.

From Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry; Snowbird, UT, USA (31 Aug 1987).

Expert robots will enhance safety and operations in nuclear plants. E. I. du Pont de Nemours and Company, Savannah River Laboratory, is developing expert mobile robots for deployment in nuclear applications at the Savannah River Plant. Knowledge-based expert systems are being evaluated to simplify operator control, to assist in navigation and manipulation functions, and to analyze sensory information. Development work using two research vehicles is underway to demonstrate semiautonomous, intelligent, expert robot system operation in process areas. A description of the mechanical equipment, control systems, and operating modes is presented, including the integration of onboard sensors. A control hierarchy that uses modest computational methods is being used to allow mobile robots to autonomously navigate and perform tasks in known environments without the need for large computer systems.

1413 **(ENR—1/148) A practical method for defouling heat exchangers.** (Alberta Energy and Natural Resources, Edmonton (Canada). Scientific and Engineering Services and Research Div.). [1987]. 8p. (MICROLOG—87-03365). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Since 1976, many projects have been initiated in Alberta by industry and by academic research institutions for better utilization of the province's energy resources. Funding for research and development efforts is supported in part by the Alberta/Canada Energy Resources Research Fund. Program priorities have focused on coal, energy preservation, renewable energy, as well as conventional energy resources. This publication deals with the results of freezing the progresive buildup of biofilm, or fouling, restoring the temperature of the heat exchanger and then flushing the liberated biofilm. Several cycles of freezing followed by fluid flow can be used. This phenomenon is referred to as "Ice Nucleation".

1414 **(EPRI-EM—5436) A continuous electric kiln for rapid sintering: Final report.** O'Brien, D.A.; Tanagho, N.F. (Harrop Industries, Inc., Columbus, OH (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 69p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920045/JAW.

Alumina-based spark plug insulators have traditionally been sintered in continuous gas-fired car tunnel kilns with cycle times of thirty to forty hours. Automation of the handling has been difficult, and large amounts of kiln furniture are required to hold the ware as it passes through the kiln. This report describes an electric alternative that drastically shortens the firing cycle while maintaining desired ceramic properties. A fast-fire, electrically-heated, continuous kiln design is proposed which minimizes kiln furniture and promotes automated handling of the insulators.

1415 **(LA-UR—87-2788) In-bore radiography for large-caliber gun.** Lucht, R.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-8710148—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014770/JAW.

From 10. international symposium on ballistics; San Diego, CA, USA (28 Oct 1987).

State-of-the-art techniques for dense object radiography, fast-transient digitization, modern computation, digital averaging and enhancement of multifilm radiographs, and microwave interferometry have been combined to provide modern propulsion and launch diagnostics for large-bore gun shots. An in-bore multifilm radiograph of a rod and sabot assembly was taken using a 2.3-MeV flash x-ray system. The launch system was radiographed ~ 1 m from the muzzle end, where the gun tube walls are >1 in. thick. Excellent spatial resolution was achieved, and the straightness of the rod was determined to within 0.1 mm. A microwave interferometer produced in-bore position-vs-time measurements. External x-ray shadowgraphs were used to view yaw and sabot separation, and dynamic pressure measurements were compared with theoretical velocity profiles. The entire set of diagnostics comprises a self-consistent description of early projectile history.

1416 **(LA-UR—87-3115) Controlling robots with spoken commands.** Beugelsdijk, T.; Phelan, P. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 12p. (CONF-8710151—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000537/JAW.

From 5. international symposium on laboratory robotics; Hopkinton, MA, USA (18 Oct 1987).

A robotic system for handling radioactive materials has been developed at Los Alamos National Laboratory. Because of safety considerations, the robot must be under the control of a human operator continuously. In this paper we describe the implementation of a voice-recognition system that makes such control possible, yet permits the robot to perform preprogrammed manipulations without the operator's intervention. We also describe the training given both the operator and the voice recognition-system, as well as practical problems encountered during routine operation. A speech synthesis unit connected to the robot's control computer provides audible feedback to the operator. Thus, when a task is completed or if an emergency develops, the computer provides an appropriate spoken message. Implementation and operation of this commercially available hardware are discussed.

1417 **(LA-UR—87-3241) Designs of pulsed power cryogenic transformers.** Singh, S.K.; Heyne, C.J.; Hackworth, D.T.; Shestak, E.J.; Eckels, P.W.; Rogers, J.D. (Los Alamos National Lab., NM (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Sep 1987. Contract W-7405-ENG-36. 5p. (CONF-870901—3). NTIS, PC A02. Order Number DE88000484/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The Westinghouse Electric Corporation has completed designs of three pulsed power cryogenic transformers for the Los Alamos National Laboratory. These transformers will be configured to transfer their stored energy sequentially to an electromagnetic launcher and form a three-stage power supply. The pulse transformers will act as two winding energy storage solenoids which provide a high current and energy pulse compression by transforming a 50 kA power supply into a megamp level power supply more appropriate for the electromagnetic launcher duty. This system differs from more traditional transformer applications in that significant current levels do not exist simultaneously in the two windings of the pulse transformer. This paper describes the designs of the pulsed power cryogenic transformers.

1418 **(LBL—23880) Studies on high-speed electroforming.** Barkey, D.P. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001395/JAW.

Studies on high-speed electroforming were undertaken to evaluate the potential for electroforming at rates comparable to those of mechanical forming. A rotating cylindrical cathode was used to provide intense turbulent convective transport. Transport in the cylindrical cell equipped with radial baffles was characterized by direct measurement of limiting currents of high rate copper deposition. Copper electroforms of thicknesses of several hundred micrometers were produced by deposition at rates of up to 7.5 A/cm^2 corresponding to 160μm per minute. A quantitative theory of morphological stability, accounting for transport, kinetic and ohmic effects, was formulated for copper deposition at high rates. Surfaces of deposits produced in the electroforming experiments were characterized by surface profilometry, and digitalized profiles were analyzed by Fourier transform for comparison with predictions of the stability theory. Decrease in roughness protrusion spacing with both increasing current density and increasing fraction of limiting current is correctly predicted. Differences between expected and observed roughness characteristics are attributed to constraints on protrusion size and spacing imposed by nucleation of growths sites. 164 refs., 48 figs., 5 tabs.

1419 **(MBB-UR—838/86) Fixed slit geometry passive phase separator for superfluid helium. Final report.** Schaellig, R.; Seidel, A.; Lieb, H.; Carl, J. (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.)). Aug 1986. 106p. (ESA-CR(P)—2357; ETN—87-90003). Issuing Activity.

A phase separator with parallel and radial flow in the fixed slits was designed for a superfluid helium cryostat. Copper, stainless steel, and glass ceramic phase separation with 8 and 10 micron slits were tested in a glass dewar in the temperature range of 1.6 to 2 K. The flow rate characteristics of the phase separators are evaluated. Test results do not totally coincide with the theory used for design. The materials used show clearly different performance characteristics which can be directly attributed to their thermal conductivity. Under all aspects relevant for an application within the ISO-cryostat, the copper phase separator with 10 to 11 micron slit width offers the best operational characteristics which seem to be closest to requirements.

1420 (N—87-26692, pp 45) **Initial planetary base construction techniques and machine implementation.** Crockford, W.W. Jun 1987. NTIS, PC A16/MF A01. (NASA-CR—171984-VOL-1; NAS—1.26:171984-VOL-1).

In National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, volume 1.

Conceptual designs of (1) initial planetary base structures, and (2) an unmanned machine to perform the construction of these structures using materials local to the planet are presented. Rock melting is suggested as a possible technique to be used by the machine in fabricating roads, platforms, and interlocking bricks. Identification of problem areas in machine design and materials processing is accomplished. The feasibility of the designs is contingent upon favorable results of an analysis of the engineering behavior of the product materials. The analysis requires knowledge of several parameters for solution of the constitutive equations of the theory of elasticity. An initial collection of these parameters is presented which helps to define research needed to perform a realistic feasibility study. A qualitative approach to estimating power and mass lift requirements for the proposed machine is used which employs specifications of currently available equipment. An initial, unmanned mission scenario is discussed with emphasis on identifying uncompleted tasks and suggesting design considerations for vehicles and primitive structures which use the products of the machine processing.

1421 **(ND-R—1276-S) Inactive trails of [intermediate level radioactive waste] transport systems: phase II. A review of progress 1984-1985.** Haberlin, M.M.; Hardy, A.R.; Kennedy, S.T. (UKAEA Risley Nuclear Power Development Establishment). Nov 1986. 105p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87752839/JAW.

Progress made during 1984-85 is reviewed in four sections: the design and installation of a stainless steel working floor in the mock-up of a crate handling and size reduction facility; the detailed evaluation of a single air pad of the type used on commercial air-transporter; an experimental programme designed to examine the problems associated with the operation of a commercial air-transporter; the design, manufacture and commissioning trials of two powered conveyor units which when combined complete a remotely operated transfer system for transporting crated waste into and within the mock-up facility.

1422 **(NP—7753278) Investigation of the efficiency of water spray curtains on the dispersion of heavy gases and its modelling. Final report.** Barth, U.; Hartwig, S.; Heudorfer, W. (Wuppertal Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 14 - Sicherheitstechnik). 30 Sep 1986. 200p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87753278/JAW.

If toxic and/or combustible gases are released in an accident at a chemical plant, these gases can be more efficiently diluted by employing water curtains. Most gases used in industry are heavy gases which show a characteristic behaviour during accident releases which is different to that of trace gases. By means of the use of water curtains the heavy gas is mixed with air, which can mitigate consequences of an accident. In this project a numeric model was established to calculate the amount of air mixed into a planar water curtain. Sensitivity tests were performed, analytic approximative solution were derived, and comparisons with experiments were carried out. In a specially constructed dispersion chamber interaction between the hazardous gas and the water curtain was examined and parameterized in a model. The results of the model are in agreement with the measurements of other wind tunnel and field experiments. With 52 refs., 34 tabs., 40 figs.

1423 **(PB—87-217477/XAB) Ishikawajima-Harima Engineering Review, Vol. 27, No. 2, March 1987.** (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1987. 75p. (In Japanese). NTIS, PC E04/MF A01.

Text in Japanese with English abstracts. See also PB—87-217485, PB—87-217493, and PB—86-198785; Portions of this document are not fully legible. Color illustrations reproduced in black and white.

Contents: a reliability evaluation system for ceramic gas turbines; development of multikilowatt closed-cycle CO laser; simplified approach for predicting lifetime on manifold header of IHX in elevated-temperature design for HTGR; decontamination of nuclear power plant components by ice-blasting technique; development of cad/cam system for boiler pressure parts; IHI SPB LNG carrier-2nd report design-; design and fabrication of 3-span continuous cable stayed bridge iwagurojima bridge for honshu-shikoku bridge authority; and coal-handling management and control system for a bulk terminal.

1424 **(RFP—4029) Low-cost teleoperator-controlled vehicle for damage assessment and dose measurement.** Tyree, W.H.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 4 Aug 1987. Contract AC04-76DP03533. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000713/JAW.

A low-cost, disposable, radio-controlled, remote-reading, ionizing radiation and surveillance teleoperator re-entry vehicle has been built. The vehicle carries equipment, measures radiation levels, and evaluates building conditions. The system includes a black-and-white video camera to observe the environment surrounding the vehicle. The camera is mounted on a vertical elevator extendable to 11 feet above the floor. The present vehicle uses a video camera with an umbilical cord between the vehicle and the operators. Video monitoring equipment is part of the operator control system. Power for the vehicle equipment is carried on board and supplied

by sealed lead-acid batteries. Radios are powered by 9-V alkaline batteries. Battery supplies for locomotion, camera, and lights are separate to ensure well-defined vehicle battery capacity while the camera and lights are in use. The radio control receiver, servo drivers, high-power amplifier and 49-MHz FM transceivers were irradiated at moderate rates with neutron and gamma doses to 3000 Rem and 300 Rem, respectively, to ensure system operation. These units performed normally during and after being exposed to these doses. 2 figs., 1 tab.

1425 **(SAND—87-0165C) Implementation of a new shock testing procedure using nonstationary random excitation.** Paez, T.L.; Baca, T.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-8710135—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014643/JAW.

From SEM fall meeting; Savannah, GA, USA (25 Oct 1987).

A new approach for the specification and performance of shock tests is described in this paper. Many field shock sources are nonstationary random processes. When a mechanical system will be subjected, in field use, to a shock drawn from a nonstationary random process source, it is best to test the system in the laboratory using a test shock drawn from the same random process source. It is shown in this paper that when a nonstationary random process is specified, realizations of the random process can be digitally generated and then reproduced on an electrodynamic shaker. Examples are presented.

1426 **(SAND—87-0276C) Comparison of real-time acousto-optic SAR [synthetic aperture radar] processor architectures.** Stalker, K.T.; Dickey, F.M.; Molley, P.A. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 10p. (CONF-8708110—19). NTIS, PC A02. Order Number DE88000428/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

A comparison of real-time acousto-optic processors for synthetic aperture radar (SAR) image formation has been performed. These processors take advantage of the high processing speed and large time bandwidth product of acousto-optic devices (AOD's) in combination with the multichannel correlation capability of charge coupled devices (CCD) to form the SAR image in real time. They offer significant size, weight and power consumption advantages compared to conventional optical or digital processors. Architectures utilizing both spatial carriers and subtraction schemes for eliminating the unwanted bias terms have been analyzed. Also, multichannel architectures for complex (quadrature) processing have been addressed. In addition to imaging performance, the impact of these approaches on system complexity, real-time processing speed and required component capabilities are discussed. Results from both our analysis and the experimental implementation of a selected group of these architectures are presented. 8 refs., 5 figs., 1 tab.

1427 **(SAND—87-1395C) The aerodynamics of supersonic parachutes.** Peterson, C.W. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 29p. (CONF-8706165—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014846/JAW.

From Parachute systems technology: fundamentals, concepts, and applications; Munich, F.R. Germany (22 Jun 1987).

A discussion of the aerodynamics and performance of parachutes flying at supersonic speeds is the focus of this paper. Typical performance requirements for supersonic parachute systems are presented, followed by a review of the literature on supersonic parachute configurations and their drag characteristics. Data from a recent supersonic wind tunnel test series is summarized. The value and limitations of supersonic wind tunnel data on hemisflo and 20-degree conical ribbon parachutes behind several forebody shapes and diameters are discussed. Test techniques were derived which avoided many of the opportunities to obtain erroneous supersonic parachute drag data in wind tunnels. Preliminary correlations of supersonic parachute drag with Mach number, forebody shape and diameter, canopy porosity, inflated canopy diameter and stability are presented. Supersonic parachute design considerations are discussed and applied to a M = 2 parachute system designed and tested at Sandia. It is shown that the performance of parachutes in supersonic flows is a strong function of parachute design parameters and their interactions with the payload wake.

1428 **(SAND—87-1762C) Materials issues in cask development.** Chapman, R.L.; Sorensen, K.B. (EG and G Idaho, Inc., Idaho Falls (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870713—57). NTIS, PC A02. Order Number DE87013010/JAW.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The OCRWM-sponsored From-Reactor Cask Systems Acquisition Program is developing a family of casks suitable for transporting commercial spent fuel. The program is procuring up to ten cask designs for further development and eventual licensing. This paper identifies potential new materials as a function of their use in the cask. To the extent that the identified materials are new (not yet qualified for their intended application), this paper identifies probable technical issues and development efforts which may be required to qualify the materials for use in transportation casks. 1 tab.

1429 **(SAND—87-1866C) Three dimensional finite element calculation of saturable magnetic fluxes and torques of an actuator.** Brauer, J.R.; Aronson, E.A.; McCaughey, K.G.; Sullivan, W.N. (Sandia National Labs., Albuquerque, NM (USA); CAD COMP, Inc., Milwaukee, WI (USA)). Aug 1987. Contract AC04-76DP00789. 4p. (CONF-870806—3). NTIS, PC A02. Order Number DE87014194/JAW.

From 6. conference on the computation of electromagnetic fields; Graz, Austria (25 Aug 1987).

A rotary magnetic actuator of highly three dimensional geometry is analyzed by the finite element method. A one quarter model composed of three dimensional finite elements is developed for analysis by the vector potential Newton Raphson approach. The nonlinear saturable magnetic fields, fluxes, inductances, energies, and torques are calculated at three armature positions. The calculated torques compare reasonably well with measurements. 7 refs., 6 figs., 2 tabs.

1430 **(SAND—87-2346) A mobile robot testbed with continuous path control for obstacle avoidance.** Ray, L.P.; Moya, M.M.; Steele, J.P.H. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA)). 1987. Contract AC04-76DP00789. 15p. NTIS, PC A02. Order Number DE88000432/JAW.

A mobile robot developed at Sandia National Laboratories as a testbed for robotic research is described. The unique features of this robot include: (1) navigation control which is distributed among a group of cooperating processes and which is organized to allow three independent levels of response based on priority, (2) three complementary obstacle avoidance sensors, and (3) multiprocessor onboard computing.

1431 **(SAND—87-8225) TOPAZ: The transient one-dimensional pipe flow analyzer: An update on code improvements and increased capabilities.** Winters, W.S. (Sandia National Labs., Livermore, CA (USA)). Sep 1987. Contract AC04-76DR00789. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001781/JAW.

TOPAZ is a "user-friendly" computer code for modeling the one-dimensional, transient physics of multi-species gas transfer in arbitrary arrangements of pipes, valves, vessels, and flow branches. This report, the fourth in a series of reports documenting TOPAZ, discusses coding improvements and the addition of new capabilities. These improvements make the current version of TOPAZ considerably more versatile than the original version which was distributed last year. For example, the new version does not restrict the user to modeling only hydrogen and helium isotope flows. Users now have the capability of modeling arbitrary gas mixture flows. In addition users may define time-dependent functions for mass generation, energy deposition, flow area, and maximum integration time step. Parallel flow paths and flows through channels having noncircular cross-sections may now be simulated. Improvements in TOPAZ mesh generation have been made which permit users to add addi-

tional "plumbing" to existing models without renumbering the mesh. 7 refs., 3 figs., 8 tabs.

1432 **(UCID—21188) Influence of strain rate and notch depth on tensile properties of HITCO 6250.** Sanchez, R.J.; Goldberg, A.; Lesuer, D.R. (Lawrence Livermore National Lab., CA (USA)). 20 Aug 1987. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001324/JAW.

Stress-strain data were obtained for HITCO 6250 material tested in uniaxial tension at nominal strain rates ranging from 0.15 to 400 in./in./s. Both double-edge-notched and notch-free specimens were tested. The effects of strain rate and notch depth are discussed.

1433 **(UCRL—96517) X-ray imaging: Status and trends.** Ryon, R.W.; Martz, H.E.; Hernandez, J.M.; Haskins, J.J.; Day, R.A.; Brase, J.M.; Cross, B.; Wherry, D. (Lawrence Livermore National Lab., CA (USA); Kevex, Inc., Foster City, CA (USA)). Aug 1987. Contract W-7405-ENG-48. 19p. (CONF-8708150—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000756/JAW.

From 36. annual Denver X-ray conference; Denver, CO, USA (3 Aug 1987).

There is a veritable renaissance occurring in x-ray imaging. X-ray imaging by radiography has been a highly developed technology in medicine and industry for many years. However, high resolution imaging has not generally been practical because sources have been relatively dim and diffuse, optical elements have been nonexistent for most applications, and detectors have been slow and of low resolution. Materials analysis needs have therefore gone unmet. Rapid progress is now taking place because we are able to exploit developments in microelectronics and related material fabrication techniques, and because of the availability of intense x-ray sources. This report describes the methods and uses of x-ray imaging along with a discussion of technology advances in these areas.

1434 **(UCRL—97378) The LLNL 150-mm equation-of-state gun system.** Rienecker, F.; Honodel, C.; Waldron, R.; Moor, E.; Perfect, S.; Bast, R. (Lawrence Livermore National Lab., CA (USA)). 22 Sep 1987. Contract W-7405-ENG-48. 35p. (CONF-8710157—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000423/JAW.

From 38. meeting of the Aeroballistics Range Association; Tokyo, Japan (6 Oct 1987).

Lawrence Livermore National Laboratory is currently designing a large gun system for expanded studies of a wide range of materials, including samples of high explosives weighing up to 10 kg. In its initial configuration, the system will have a 150-mm bore, 20-m-long, single-stage gun that can fire a 10-kg projectile at velocities of 2.2 km/s. Future plans include conversion either to a two-stage gun, or to a single-stage 100-mm gun, and conversion to a ballistic range. The high-explosive samples will be contained in a stainless steel tank that is 3.8 m in diameter, 12.5-m long, and 89-mm thick. This paper emphasizes improvements in the gun design, including tube couplings that use large coupling nuts and elastic interference fits to achieve precise alignment, a rail support system that allows rapid changes of configuration without need for realignment, and a barrel venting experiment designed to reduce projectile tilt in free flight. In addition, the authors discuss a computer modeling experiment in which they examined the effects of stress and strain on one part of the gun, the breech. Results showed that peak stresses would cause the breech to deform, producing autofrettaged conditions.

1435 **(Y—2389) Chip breaking on uranium alloy.** Morris, T.O.; Tharp, M.J. (Oak Ridge Y-12 Plant, TN (USA)). Sep 1987. Contract AC05-84OS21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001454/JAW.

Tests were conducted to determine the feasibility of breaking uranium-6% niobium machining chips with high-pressure coolant. Results showed that, with the proper parameters, the chips could be broken at all points around 90 degrees of a machined contour. The results of the tests are given, along with recommendations for parameters to break chips.

1436 **(Y/DV—659) An optical measurement system for monitoring blank location during superplastic forming.** Bridges, R.L.; Ludtka, G.M. (Oak Ridge Y-12 Plant, TN (USA)). 10 Sep 1987. Contract AC05-84OS21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014576/JAW.

During superplastic forming a system is needed that can accurately measure the forming blank location throughout the process with no interference to the blank. Currently, there is no way of knowing when actual forming takes place with the exception of interrupting the forming process at specific intervals and comparing the partially formed blank with its predicted geometry. Rapid grain-growth during superplastic forming prohibits the partially formed blanks from being reheated and forming continued, therefore, these blanks would become scrap material. Several systems based on different physical, electronic, and optical devices were considered before selecting the present system consisting of a linear detector monitoring the image movement of a fixed laser as forming proceeds. The following report details the necessity and the evolution of the optical measurement system that is presently being built.

1437 **Energy absorption device.** Hertelendy, N.A. (to Dept. of Energy). US Patent Application 6-006,868. 27 Jan 1987. 15p. Contract AC06-77RL01030. DE88000861 NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000861/JAW.

An energy absorbing device comprising two metal elements slip-fit together. The inner element has an enlarged portion thereupon which is forced, by a force overload to travel along the inside of the outer tube. The energy of the overload is absorbed by the forces of friction and deformation as the two elements are telescoped together.

1438 **Discriminating ultrasonic proximity detection system.** Annala, W.C. (to Dept. of Energy). US Patent Application 6-937,781. 4 Dec 1986. 31p. Contract W-7405-ENG-48. DE88000846 NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000846/JAW.

This invention uses an ultrasonic transmitter and receiver and a microprocessor to detect the presence of an object. In the reset mode the invention uses a plurality of echoes from each ultrasonic burst to create a reference table of the echo-burst-signature of the empty monitored environment. The invention then processes the reference table so that it only uses the most reliable data. In the detection mode the invention compares the echo-burst-signature of the present environment with the reference table, detecting an object if there is a consistent difference between the echo-burst-signature of the empty monitored environment recorded in the reference table and the echo-burst-signature of the present environment.

1439 **Optical fiducial timing system for x-ray streak cameras.** Nilson, D.G.; Campbell, E.M.; MacGowan, B.J.; Medecki, H. (to Dept. of Energy). US Patent Application 6-937,792. 4 Dec 1986. 29p. Contract W-7405-ENG-48. DE88000847 NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000847/JAW.

An optical fiducial timing system is provided for use with interdependent groups of x-ray streak cameras. The aluminium coated ends of optical fibers are positioned with the photocathodes of the x-ray streak cameras. The other ends of the optical fibers are placed together in a bundled array. A fiducial optical signal, that is comprised of 2ω or 1ω laser light, after introduction to the bundled array, travels to the aluminum coated optical fiber ends and ejects quantities of electrons that are recorded on the data recording media of the x-ray streak cameras. Since both 2ω and 1ω laser light can travel long distances in optical fiber with only a slight attenuation, the initial arial power density of the fiducial optical signal is well below the damage threshold of the fused silica or other material that comprises the optical fibers. Thus the fiducial timing system can be repeatably used over long durations of time.

1440 **Apparatus for simultaneously disreefing a centrally reefed clustered parachute system.** Johnson, D.W. (to Dept. of Energy). US Patent Application 6-922,425. 23 Oct 1986. 20p. Contract AC04-76DP00789. DE88000882 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000882/JAW.

A single multi-line cutter is connected to each of a cluster of parachutes by a separate short tether line that holds the parachutes, initially reefed by closed loop reefing lines, close to one another. The closed loop reefing lines and tether lines, one from each parachute, are disposed within the cutter to be simultaneously cut by its actuation when a central line attached between the payload and the cutter is stretched upon deployment of the cluster. A pyrotechnic or electronic time delay may be included in the cutter to delay the actual simultaneous cutting of all lines until the clustered parachutes attain a measure of stability prior to being disreefed. A second set of reefing lines and second tether lines may be provided for each parachute, to enable a two-stage, separately timed, step-by-step disreefing.

1441 **Inflatable wing.** Priddy, T.G. (to Dept. of Energy). US Patent Application 6-919,995. 17 Oct 1986. 15p. Contract AC04-76DP00789. DE88000879 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000879/JAW.

An inflatable wing is formed from a pair of tapered, conical inflatable tubes in bonded tangential contact with each other. The tubes are further connected together by means of top and bottom reinforcement boards having corresponding longitudinal edges lying in the same central diametral plane passing through the associated tube. The reinforcement boards are made of a still reinforcement material, such as Kevlar, collapsible in a direction parallel to the spanwise wing axis upon deflation of the tubes. The stiff reinforcement material cooperates with the inflated tubes to impart structural I-beam characteristics to the composite structure for transferring inflation pressure-induced tensile stress from the tubes to the reinforcement boards. A plurality of rigid hoops shaped to provide airfoil definition are spaced from each other along the spanwise axis and are connected to the top and bottom reinforcement boards. Tension lines are employed for stabilizing the hoops along the trailing and leading edges thereof. 5 figs.

1442 **Optical absorption measurement system.** Draggoo, V.G.; Morton, R.G.; Sawicki, R.H.; Bissinger, H.D. (to Dept. of Energy). US Patent Application 6-908,482. 17 Sep 1986. 58p. Contract W-7405-ENG-48. DE88000868 NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000868/JAW.

The system of the present invention contemplates a non-intrusive method for measuring the temperature rise of optical elements under high laser power optical loading to determine the absorption coefficient. The method comprises irradiating the optical element with a high average power laser beam, viewing the optical element with an infrared camera to determine the temperature across the optical element and calculating the absorption of the optical element from the temperature.

1443 **System and method for linearly amplifying optical analog signals by background Raman scattering.** Lin, Cheng-Heui. (to Dept. of Energy). US Patent Application 6-902,839. 2 Sep 1986. 12p. Contract AC08-83NV10282. DE88000864 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000864/JAW.

A system for linearly amplifying an optical analog signal by backward stimulated Raman scattering comprises a laser source for generating a pump pulse; and an optic fiber having two opposed apertures, a first aperture for receiving the pump pulse and a second aperture for receiving the optical analog signal, wherein the optical analog signal is linearly amplified to an amplified optical analog signal. 4 figs.

4203 Lasers

REFER ALSO TO CITATION(S) 1291, 1593, 2106, 2117, 2685

1444 **(AD-A—182987/8/XAB) Free-electron laser research at the University of California, Santa Barbara.** Elias, L.R. (California Univ., Santa Barbara (USA). Dept. of Physics). 1987. 20p. NTIS, PC A02/MF A01.

A review of free-electron laser research is presented. Among the topics included are: 1) the development of high-quality electron-beam sources based on electrostatic accelerating fields, 2) the analysis of present FEL operating characteristics, 3) the development of advanced FEL concepts, and 5) the utilization of the FEL in scientific research.

1445 **(AD-A—183072/8/XAB) Optical gain, phase shift, and profile in free-electron lasers. Interim report.** Hafizi, B.; Sprangle, P.A.; Ting, A. (Naval Research Lab., Washington, DC (USA)). 20 Jul 1987. 49p. (NRL-MR—5998). NTIS, PC A03/MF A01.

The gain, phase shift, wavefront curvature and radius of the radiation envelope in a free-electron-laser amplifier are obtained in the small signal regime. The electron beam is assumed to have a Gaussian density distribution in the transverse direction. Numerical calculations indicate that the radius and curvature of the radiation beam entering a wiggler asymptote have unique, spatially constant values after a finite transition region. However, in the asymptotic region, the wavefronts are divergent. Analytical expressions for the gain, phase shift, curvature, and spot size are derived. It is shown analytically that small perturbations of the optical waist and curvature about the matched value are spatially damped out, indicating the stability of the matched envelope. When the electron beam envelope is modulated in space, the optical spot size oscillates with an almost identical wavelength but is delayed in phase. In the case of small-amplitude long-wavelength betatron modulation of the electron-beam envelope, generation of optical sidebands in wavenumber space is examined, and the effect on the dispersions characteristics of the primary wave is found to be negligible for typical experimental parameters.

1446 **(CEA-CONF—8831) Development of the SCA/FEL for use in bio-medical and materials science experiments.** Smith, T.I.; Schwettman, H.A.; Rohatgi, R.; Lapierre, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Sep 1986. 27p. (CONF-8609131—13). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752750/JAW.

From 8. international free electron laser conference; Glasgow, UK (1 Sep 1986).

The superconducting accelerator driven free electron laser (SCA/FEL) has been funded as a versatile source of infrared and visible photons for biomedical and materials research. The funding program includes a new helium refrigerator which will permit the SCA/FEL to be maintained at helium temperature continuously and to be operated seven hours per day five days per week. The experimental capabilities of this facility are discussed in Section II of this paper. In Section III we discuss the immediate opportunities for expanding the capabilities of this facility, and for exploring accelerator physics and the Free Electron Laser system questions. Discussions in Section III include the possibility of lasing in the near ultraviolet at 0.2 μ and the possibility of achieving high FEL efficiency through "same cell" energy recovery.

1447 **(CONF-860778—Vol.3) Proceedings: SDIO/DARPA workshop on laser propulsion: Volume 3, Viewgraphs.** Kare, J.T. (ed.). (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 246p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88000964/JAW.

From SDIO/DARPA workshop on laser propulsion; Livermore, CA, USA (7 Jul 1986).

This report discusses the concept of laser propulsion with regard to rockets and space vehicles. Topics covered are: laser propulsion to earth orbit; adaptive optics; free electron lasers; the Mercury Lightcraft concept; laser thermal propulsion; the ten-meter tel-

escope; laser steering concepts; cw laser propulsion; and detonation-wave rockets.

1448 **(LA-UR—87-1268) Comparison of sideband spectra obtained from analytical formula and from numerical simulation in free-electron laser.** Takeda, H. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 14p. (CONF-870622—10). NTIS, PC A02. Order Number DE88000521/JAW.

From 19. fluid dynamics, plasma dynamics, and laser conference; Honolulu, HI, USA (8 Jun 1987).

The sideband spectrum appearing in the free-electron laser is analyzed. For an untapered undulator, we predict the wavelengths of local peaks arising from the sidebands; they are compared with numerical simulations. In our analytical theory, three laser-driving terms are derived. One term does not chirp in frequency, drives a number of frequencies simultaneously, and is always the strongest term with a fixed strength. The other two driving terms, which also drive multiple frequencies, chirp to both directions from a resonant frequency. We assume that the sidebands originate from a dipole oscillation of average electron energy. This oscillation frequency is equal to the synchrotron oscillation frequency. The theory predicts that the strength of the chirping terms is proportional to the amplitude of the dipole moment.

1449 **(LA-UR—87-2808) Analysis of sideband spectra from untapered undulator using analytical technique.** Takeda, H. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 25p. (CONF-8709110—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014763/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

The sideband spectrum appearing in the free-electron laser is analyzed. For an untapered undulator, we predict the wavelengths of local peaks arising from the sidebands; they are compared with numerical simulations. In our analytical theory, three laser-driving terms are derived: one term does not chirp in frequency, drives a number of sidebands simultaneously, and is always the strongest term with a fixed strength. The other two driving terms, which also drive multiple frequencies, chirp to both directions from a resonant frequency. We assume that the sidebands originate from a dipole oscillation of average electron energy where the average energy oscillates with the synchrotron oscillation frequency.

1450 **(LA-UR—87-2856) Long-range pulselength scaling of 351nm laser damage thresholds.** Foltyn, S.R.; Jolin, L.J. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 14p. (CONF-8611154—2). NTIS, PC A02. Order Number DE87014754/JAW.

From Boulder damage symposium; Boulder, CO, USA (3 Nov 1986).

In a series of experiments incorporating 351nm pulselength of 9, 26, 54, and 625ns, it was found that laser damage thresholds increased as (pulselength)/sup x/, and that the exponent averaged 0.36 and ranged, for different samples, from 0.23 to 0.48. Similar results were obtained when only catastrophic damage was considered. Samples included Al_2O_3/SiO_2 in both AR and HR multilayers, HR's of Sc_2O_3/SiO_2 and HfO_2/SiO_2, and Al-on-pyrex mirror; 9ns thresholds were between 0.2 to 5.6 J/cm². When these data were compared with a wide range of other results - for wavelengths from 0.25 to 10.6 microns and pulselengths down to 4ps - a remarkably consistent picture emerged. Damage thresholds, on average, increase approximately as the cube-root of pulselength from picoseconds to nearly a microsecond, and do so regardless of wavelength or material under test. 18 refs.

1451 **(LA-UR—87-2910) The lasertron rf generator for FEL [free-electron laser] applications.** Tallerico, P.J. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 11p. (CONF-8709110—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000515/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

The lasertron rf generator uses an rf-modulated laser beam to generate a tightly bunched electron beam that is accelerated by a dc power supply to the fractional megawatt region. The tightly bunched beam then crosses an output cavity where most of the kinetic energy may be extracted. The bunching is so good that efficient microwave generation at 3 GHz and above is feasible, and three projects worldwide are under way for these frequencies. All three existing projects focus on the linear collider application of high peak power with good efficiency, short output pulses, and low average power. A short review of these projects is presented. The main thrust of this paper is to discuss the lasertron as the rf generator for free-electron laser (FEL) rf systems. The author has developed a ring model of the lasertron device that shows excellent dc-to-rf conversion efficiency at high output power over the 400- to 1700-MHz frequency range. The issue of the lasertron advantages at higher average output power is also explored. First-order estimates of the weight versus frequency and power are also made. An outline of an experiment that uses the Los Alamos photoinjector to make a lasertron is also presented. 7 refs., 3 figs.

1452 **(LA-UR—87-2911) High-power rf-pulsed modulators for the Los Alamos free-electron laser.** Johnson, W.J.D.; Lynch, M.T.; Tallerico, P.J.; Keffeler, D.R.; Hornkohl, J.O. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 10p. (CONF-8709110—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000514/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

In the rf-driven free-electron laser (FEL) at the Los Alamos National Laboratory, there are two pulsed-power rf modulators as sources for two tandem, side-coupled 20-MeV linear accelerators. The rf power used to control the cavity fields is supplied by two 5.5-MW modulating anode klystrons operating at a center frequency of 1300.2 MHz. The modulation of the 125 kV klystron is achieved by using a triode switch tube that provides a pulse width up to 300 μs and a pulse repetition rate up to 10 Hz. This paper describes the present configuration of these two duplicate systems and presents plans for meeting the requirements of future rf FEL experiments at Los Alamos. 12 refs., 5 figs.

1453 **(LA-UR—87-3013) Output power enhancement of ac Raman free-electron laser.** Yan, Y.T. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 19p. (CONF-8709140—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000503/JAW.

From 9. international free electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

The ac free-electron laser (ac FEL) uses an ac (temporally oscillating but spatially uniform) field as the pump source with the hope that electromagnetic radiation will be produced with wavelength shorter than that can be generated by a conventional magnet FEL. The ac field can be provided by a superconducting cavity or by a plasma wave. In this note, the effects of the thermal motion of the electron beam on the linear gain and the nonlinear saturated output power in a Raman-regime ac FEL with the launch of an electromagnetic signal wave by particle-in-cell simulations are investigated. The output power enhancement of the ac FEL either by imposing an appropriate axial electric field at the time of radiation saturation or by properly tapering the strength or the frequency of the ac pump is discussed.

1454 **(LA-UR—87-3035) The generation and suppression of synchrotron sidebands.** Warren, R.W.; Goldstein, J.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 26p. (CONF-8709110—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000532/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

Computer simulations of FEL lasing differ in the degree to which they approximate real experiments. One of the FEL codes used extensively at Los Alamos takes account of the features of each electron micropulse and follows the growth and saturation of the optical micropulse. With no additional adjustments, this code displays the development of sidebands and demonstrates their control when optical filters of various kinds are used. Other codes that do not include a description of the micropulse do not automatically display sidebands but need to have artificial noise of some kind

added. This is not unexpected because sidebands are generated by an FEL instability; instabilities, in general, need some kind of initiating disturbance. In this paper we: identify the disturbance that triggers the instability in the pulse code; discuss a practical way to suppress the instability without using filters; compare these results with experiments; and discuss these findings. 22 refs., 9 figs.

1455 **(LA-UR—87-3036) The Los Alamos Photoinjector Program.** Sheffield, R.L.; Gray, E.R.; Fraser, J.S. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 18p. (CONF-8709110—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000531/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

Free-electron lasers (FELS) require electron beams of high peak brightness. In this presentation, we describe the design of a compact high-brightness electron source for driving short-wavelength FELs. The experiment uses a laser-illuminated Cs_3Sb photoemitter located in the first rf cavity of an injector linac. The photocathode source and associated hardware are described. The doubled YAG laser (532 nm), which is used to drive the photocathode, produces 75-ps micropulses at 108-MHz repetition rate and peak powers of approximately 300 kW. Diagnostics include a pepper-pot emittance analyzer, a magnetic spectrometer, and a 4-ps resolution streak camera. Present experiments give the following results: micropulse current amplitude of 100 mA to 400 A, beam emittances ranging from 10 n.mm.mrad to 40 n.mm.mrad, an energy spread of +-3%, and peak current densities of 600 A/cm^2. A brief discussion on the possible applications of this very bright and compact electron source is presented. 16 refs., 5 figs., 1 tab.

1456 **(N—87-26328) Direct solar-pumped iodine laser amplifier. Semiannual progress report, 1 March-31 August 1986.** Han, K.S.; Kim, K.H.; Stock, L.V. (Hampton Inst., VA (USA)). Nov 1986. 42p. (NASA-CR—180296; NAS—1.26:180296). NTIS, PC A03/MF A01.

In order to evaluate the feasibility of the solar pumped dye laser, the parametric study of a dye laser amplifier pumped by a solar simulator and flashlamp was carried out, and the amplifier gains were measured at various pump beam irradiances on the dye cell. Rhodamine 6G was considered as a candidate for the solar pumped laser because of its good utilization of the solar spectrum and high quantum efficiency. The measurement shows that a solar concentration of 20,000 is required to reach the threshold of the dye. The work to construct a kinetic model algorithm which predicts the output parameter of laser was progressed. The kinetic model was improved such that there is good agreement between the theoretical model and experimental data for the systems defined previously as flashlamp pumped laser oscillator, and the long path length solar pumped laser.

1457 **(N—87-26329) High energy efficient solid state laser sources. Semiannual progress report, period ending 31 March 1987.** Byer, R.L. (Stanford Univ., CA (USA)). Apr 1987. 11p. (NASA—180536; NAS—1.26:180536). NTIS, PC A02/MF A01.

Diode-laser-pumped solid-state laser oscillators and nonlinear processes were investigated. A new generation on nonplanar oscillator was fabricated, and it is anticipated that passive linewidths will be pushed to the kilohertz regime. A number of diode-pumped laser transitions were demonstrated in the rod configuration. Second-harmonic conversion efficiencies as high as 15% are routinely obtained in a servo-locked external resonant doubling crystal at 15 mW cw input power levels at 1064 nm.

1458 **(N—87-26330) Direct solar-pumped iodine laser amplifier. Semiannual progress report, 1 September 1986-28 February 1987.** Han, K.S.; Kim, K.H.; Stock, L.V. (Hampton Inst., VA (USA)). Feb 1987. 98p. (NASA-CR—180541; NAS—1.26:180541). NTIS, PC A05/MF A01.

The improvement on the collection system of the Tarmarack Solar Simulator beam was attemped. The basic study of evaluating the solid state laser materials for the solar pumping and also the work to construct a kinetic model algorithm for the flashlamp pumped iodine lasers were carried out. It was observed that the collector cone worked better than the lens assembly in order to collect the solar simulator beam and to focus it down to a strong power density. The study on the various laser materials and their lasing characteristics shows that the neodymium and chromium codoped gadolinium scandium gallium garnet (Nr:Cr:GSGG) may be a strong candidate for the high power solar pumped solid state laser crystal. On the other hand the improved kinetic modeling for the flashlamp pumped iodine laser provides a good agreement between the theoretical model and the experimental data on the laser power output, and predicts the output parameters of a solar pumped iodine laser.

1459 **(N—87-26531, pp vp) Free-electron laser simulations on the MPP.** Vonlaven, S.A.; Liebrock, L.M. (Michigan Technological Univ., Houghton). Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

Free electron lasers (FELs) are of interest because they provide high power, high efficiency, and broad tunability. FEL simulations can make efficient use of computers of the Massively Parallel Processor (MPP) class because most of the processing consists of applying a simple equation to a set of identical particles. A test version of the KMS Fusion FEL simulation, which resides mainly in the MPPs host computer and only partially in the MPP, has run successfully.

1460 **(PB—87-217493/XAB) Development of multikilowatt closed-cycle CO laser.** Kanazawa, H.; Yamaguchi, N.; Watanabe, K.; Taira, T.; Saito, H. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1987. 7p. (In Japanese). NTIS, PC E04/MF A01.

Included in Ishikawajima-Harima Engineering Review, Vol. 27, No. 2, 78-83(Mar 1987).

A closed-cycle self-sustained-discharge-excited CO laser with a subsonic gas flow scaled to multikilowatt output power has been developed; the device is characterized by the fact that gas temperature can be controlled from the room temperature to about 100 K with two heat exchangers using freon R502 and liquid nitrogen as coolants. An experimental optimization of various gas parameters such as composition, temperature, pressure and velocity are carried out with mixed gas of $CO/N_2/O_2/He$ using the Z-shaped folded resonator. A maximum laser output power of 3.1 kW at an ascillation efficiency of 16% was obtained at the conditions of 70 Torr charged gas pressure, 170 K gas temperature, while a maximum oscillation efficiency of 25% was obtained for 1.6-kW laser output power with 30 Torr charged-gas pressure, 110 K gas temperature.

1461 **(UCRL—96662) Thermal stress in the edge cladding of Nova glass laser disks.** Pitts, J.H.; Kong, M.K.; Gerhard, M.A. (Lawrence Livermore National Lab., CA (USA)). 28 Sep 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—3). NTIS, PC A02. Order Number DE88000425/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

We calculated thermal stresses in Nova glass laser disks having light-absorbing edge cladding glass attached to the periphery with an epoxy adhesive. Our closed-form solutions indicated that, because the epoxy adhesive is only 25 μm across, it does not significantly affect the thermal stress in the disk or cladding glass. Our numerical results showed a peak tensile stress in the cladding glass of 24 MPa when the cladding glass had a uniform absorption coefficient of 7.5 cm^{-1}. This peak value is reduced to 19 MPa if surface parasitic oscillation heating is eliminated by tilting the disk edges. The peak tensile stresses exceed the typical 7 to 14-MPa working stress for glass; however, we have not observed any disk or cladding glass failures at peak Nova fluences of 20 J/cm^2. We have observed delamination of the epoxy adhesive bond at fluences several times that which would occur on Nova. Replacement laser disks will incorporate cladding with a reduced absorption coefficient of 4.5 cm^{-1}. Recent experiments show that this reduced absorption coefficient is satisfactory.

1462 **Transverse ring RF line for CO/sub 2/ laser.** Fox, C.S.; Nettleton, J.E.; Barr, D.N. (to Secretary of the Army, Washington, DC). US Patent 4,689,798. 25 Aug 1987. Filed date 31 Jul 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A gas filled waveguide laser tube is described for use in a Fabry-Perot cavity to generate electromagnetic radiation (EMR) within a far-infrared band of wavelengths, comprising: an elongated tube of dielectric material having a cross-section necessary to achieve a desired moding or polarization, the tube being characterized by low loss propagation of high frequency EMR; a pair of end caps hermetically sealing the ends of the tube, the caps being transparent to the far-infrared band of EMR; an ionizable polyatomic gas at low pressure within the tube; a pair of diametrically opposed line conductors extending along the axis of the tube for at least the length of the gas filled portion thereof and; a series of ring shaped electrodes having a defined cross-section alternately connected to the conductors and extending around and touching the tube normal to the axis thereof for at least 75% of its circumference, the rings being electrically coupled to the line conductors to form a transmission line for RF excitation.

1463 **Frequency locking in coupled free electron lasers.** Chow, W. W.; Appert, Q. D.; Saxman, A. C.; Mcvey, BRIAN; Bender, S. C. (Hughes Aircraft Co., Albuquerque, NM; Los Alamos National Laboratory, NM). pp 5 of AIAA, fluid dynamics, plasma dynamics, and lasers conference. Honolulu, HI; AIAA (1987). (AIAA-Paper—87-1281; CONF-870191—).

From 19. AIAA fluid dynamics, plasma dynamics, and lasers conference; Honolulu, HI, USA (8 Jan 1987).

An optical-phased-array technique for increasing the output power, beam agility, and equivalent output aperture of an FEL is described. The technique employs a master oscillator (MO) to drive a linear chain of power amplifiers (PAs) to produce closely packed frequency-locked output beams of equal intensity. A sample system is described, comprising an MO with preamplifier output 7.2 GW at 1.005 microns, parabolic-taper wiggler wavelength varying from 35.35 to 20.50 mm, wiggler length 15.70 m, and magnetic flux 4.125 kG and PAs with beam current 500 A, gamma 184.19, beam radius 1.3 mm, and output 14.4 GW at 15-percent efficiency. The output of this array would be four beams of 20-ps 7.2-GW micropulses, corresponding to 576 J per macropulse (1000 micropulses) or average ouput power (for an accelerator operating at 180 Hz) of 100 kW. It is estimated that the gain-induced phase shift of the array output could be easily corrected by the telescope array used to focus the output on a target.

1464 **Measurements of excited-state loss rates caused by amplified spontaneous emission in laser disks.** Murray, J.E.; Powell, H.T.; Trenholme, J.B.; Woods, B.W. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550). pp 140-142 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Technical Paper WI3.

Amplified spontaneous emission (ASE) strongly influences the performance of large-aperture Nd:glass disk amplifiers. Even with perfectly absorbing edge claddings on the disks, depumping caused by single-pass ASE increases rapidly with aperture, reducing peak gain and storage efficiency. The loss rate due to ASE is, therefore, very important for modeling disk amplifier performance and ultimately limits the aperture to which individual amplifier disks can be scaled. The authors measured the instantaneous excited-stated loss rate caused by ASE in large-aperture disks. To their knowledge this is the first quantitative measurement of this effect. They determined the ASE loss rate by measuring both the small-signal gain in the amplifier disk and the fluorescence from a small diagnostic disk which is pumped by the same flashlamp light as the amplifier disk. The greatly reduced pumping intensity to which the diagnostic disk is exposed eliminates ASE effects in its fluorescence signal. The authors describe that if the diagnostic disk sees the same flashlamp spectrum as the amplifier disk, its pumping rate will be proportional to that of the amplifier disk so that $p(t) = B*P(t)$. They record gain and fluorescence waveforms digitally and use digital smoothing and differentiating to obtain g(t), f(t), g(t), and f(t). The results from Monte Carlo ray-tracing calculations of the ASE decay rate are also shown.

1465 **Large-aperture high-power third harmonic conversion using a type I/type II phase matching scheme.** Wegner, P.J.; Henesian, M.A.; Weiland, T. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94450). pp 70 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Birefringence in large-aperture high-power solid-state laser systems for fusion research is a potential limit to achieving efficient frequency converted performance to the second and third harmonic wavelengths. Even intrinsic levels of stress-induced birefringence in optical components can produce regions of depolarization in the output beam. Intensity-dependent ellipse rotation effects in the laser glass and intervening air paths increase the depolarization which can seriously degrade the efficiency of type II/type II KDP frequency converters. Repolarization of the fundamental output beam has shown high conversion efficiency and good pulse fidelity but requires the use of a large-aperture high-rejection ratio thin-film polarizer that can be operated at fluences of >5 J/cm/sup 2/. The authors report here an alternative method for frequency-tripling solid-state lasers that do not require beam repolarization. Experiments using the LLNL Nova laser have successfully demonstrated that a large-aperture two-crystal type I/type II system can achieve 69% energy conversion to the third harmonic with an imperfectly polarized 1053-nm beam. Temporal records of the 1ωdrive and 3ω converted pulses show that a fundamental pulse shape is maintained in the process. The experiments were conducted in a 20-cm subaperture of the 74-cm Nova beam. Average depolarization in the chose region was measured to be —2.5%. Third harmonic pulses were generated with 1.2-cm thick type I and 0.985-cm thick type II ar coated KDP crystals oriented.

1466 **Electron-beam energy deposition modeling for the KrF laser.** Schneider, B.I.; Comly, J. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). pp 70 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

A 3-D Monte Carlo electron-beam energy deposition code is used to study the effects of e-beam voltage, gas density, gas mix, foil material, and laser geometry on the uniformity of energy deposition in large KrF laser amplifiers. For inertial confinement fusion applications, large KrF laser amplifiers may ultimately be feasible, if, among other factors, uniform and efficient pumping by a relativistic electron beam can be achieved in practice. Counterposed electron beams is one means which has been under consideration for some time. Parametric studies were performed to determine the trade-off between voltage, density, and amplifier width for specific uniformity and efficiency requirements. Model calculations were also performed for conditions reported in the literature and compared to the experimental results and other models.

1467 **Absorption processes in the KrF laser.** Schneider, B.I. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). pp 72 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

To understand the absorption and emission spectra and molecular dynamics in rare gas halide lasers, it is essential to characterize the potential surfaces of various triatomic species. Although there has been much progress in development of ab initio methods of quantum chemistry over the past few years, it is still difficult and expensive to calculate these surfaces without resorting to some sort of semitheoretical technique. In may cases it is possible to combine the two approaches to produce accurate potential curves and transition moments for polyatomic systems. Recent experimental evi-

dence suggests that there are absorbers in the KrF laser mixtures which are ignored by kinetic models. These absorbers may be other states or configurations of Kr/sub 2/F ignored by previous researchers or other polyatomic molecules not envisioned as playing a major role in the kinetic models. An attempt is made to calculate some of the states of these polyatomics and to examine their absorption properties with an eye to explaining the discrepencies between existing theory and experiment. The DIM method is used as the major computational approach with the needed diatomic curves taken from experiment or theory. Ab initio calculations are performed at selected geometries to check the validity of the DIM and accuracy of the transition moments.

1468 **Ultrashort pulse measurement with induced gratings.** Nighan, W.L. Jr.; Fauchet, P.M.; Trebino, R. (Princeton Univ., Dept. of Electrical Engineering, Princeton, NJ 08544). pp 78-80 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Several techniques are developed for ultrashort pulse measurement. Streak cameras yield the pulse shapes directly but are expensive and limited to 1-ps time resolution. Autocorrelation by second harmonic generation (SHG) attains femtosecond time resolution and distinguishes between transform-limited and nontransform-limited pulses but requires phase matching in special crystals that must be transparent at both ω and 2ω. The authors propose a novel technique that allows easy and accurate determination of the pulse duration tau/sub rho/ and the coherence time tau/sub c/, can be used at any wavelength, does not necessarily require phase matched geometries in special crystals, and is inexpensive and simple to implement. Different arrangements are possible that all have in common the formation of a transient grating by interference of two pulses in an absorbing medium and the measurement of the energy of a diffracted beam as a function of time delay between the two writing beams. This diffracted beam may be produced by either one of the two writing beams or a third beam. They present results obtained using different geometries and visible picosecond pulses from a Nd:YAG laser and dye laser. The medium in which the grating is written is either a thin silicon film or a rhodamine 6G dye cell. Most results obtained with poorly, partially, or well-mode-locked pulses agree well with theory. However, some results obtained with partially mode-locked pulses show dips on either side of the coherence spike, which probably result from partial-coherence effects not present in the models employed here. These departures from the expected shape can lead to a better description of partially mode-locked pulses.

1469 **Progress in the growth of large-diameter flat interface YAG:Nd.** Brown, A.M.; Morris, R.C.; Marion, J.E. (Allied-Signal Corp., P.O. Box 1021R, Morristown, NJ 07960). pp 36 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

The master oscillator for the proposed free electron laser program at Lawrence Livermore National Laboratory requires a high-repetition-rate moderate energy laser operating at —1-μm wavelength with exceptionally good beam quality. Y/sub 5/Al/sub 3-/O/sub 12/:Nd, because of its high-emission cross section and good thermomechanical properties, is the material of choice. The nominal requirements are for zigzag laser plates, 1 x 7 x 20 cm in size, with concurrent excellent optical quality. A dramatic advance in the state of the art for growing YAG is required to provide core-free material of the size required (8.5-cm diam boules). Under contract to LLNL, Allied Corp. in Morristown undertook the task of defining the problems and developing solutions for achieving this growth. The initial experimentation was conducted on 1-in. diam Nd:YAG boules and directed toward two goals: defining the conditions for flat interface growth and implementing melt replenishment to keep both the melt level and neodymium concentration constant. The authors found that the observable melt flow transitions in our system occur at a crystal rotation rate of —65 rpm. The crystal-melt interface transition from conical to rounded convex to flat occurs in the crystal rotation rate range of 50-70 rpm. Growth experiments in this rotation rate region are directed towards scaling the flat interface growth to larger diameter crystals. Melt replenishment experiments, using the periodic addition of small YAG pellets to the melt, indicate that melt leveling is achievable.

1470 **Two-photon absorption cross section of Nd/sup 3+/ in Y/sub 3/Al/sub 5/O/sub 12/ and LiYF/sub 4/ hosts near 1.06 μm.** Payne, S.A.; Chase, L.L. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550). pp 36 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

The authors measured and calculated from the Judd-Ofelt theory the two-photon absorption (TPA) cross section for the /sup 4/I/sub 9/2/ → /sup 4/G/sub 7/12/ transitions of Nd/sup 3+/ in Y/sub 3/Al/sub 5/O/sub 12/ (YAG) and YLiF/sub 4/ (YLF). These transitions are particularly significant because they occur near the two-photon energy of the typical 1.06-μm operating wavelength of a Nd/sup 3+/ solid-state laser. Therefore, TPA may be a loss mechanism in high-peak-power Nd/sup 3+/ lasers. The TPA spectrum of Nd/sup 3+/:YAG at 10 K is displayed. Also noted is the energy of twice the operating frequency of the Nd/sup 3+/ :YAG laser. There is no overlap with the TPA transitions at low temperature. At room temperature, however, the thermal population of the ground-state multiplet and the thermal broadening of the lines result in some degree of overlap. The transitions of Nd/sup 3+/-doped glasses are always two-photon resonant due to the inhomogeneous broadening of the spectral features in amorphous hosts. The values of Δ/sub exp/ that they measured are 1.2 and 0.15 x 10/sup -40/ cm/sup 4/ for Nd/sup 3+/:YAG and Nd/sup 3+/:YLF, respectively. Interestingly, they find that the value of Δ/sub exp/ is almost an order of magnitude larger for the YAG host. Despite the apparent host dependence, their measured values of the TPA cross section are in reasonable agreement with the theoretical calculations. Their values of δ show that TPA is expected to be <10/sup -3/ cm/sup -1/ in a high-peak-power laser system and, therefore, do not present a substantial loss mechanism in a solid-state laser system based on the Nd/sup 3+/ ion.

1471 **Laser material characteristics of Ti:Al/sub 2/O/sub 3/.** Birnbaum, M.; Pertica, A.J. (Univ. of Southern California, Center for Laser Studies, Los Angeles, CA 90089). pp 60 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Quasi-cw laser characteristics of Ti:Al/sub 2/O/sub 3/ were obtained utilizing a chopped cw Ar/sup +/ laser pump beam. This arrangement facilitated precise alignment of the Ti:Al/sub 2/O/sub 3/ rod and resonator for minimum threshold. The low-duty cycle employed circumvented the deleterious thermal effects usually encountered in cw pumping. At threshold with plane parallel broadband mirrors peaking at 790 nm, the laser output occurred in a narrowband, <10 nm, centered at 780 nm. A typical laser output wavelength band as a function of the pump power is presented. The results for three Ti:Al/sub 2/O/sub 3/ laser rods are also shown. A scanning knife-edge method was used to obtain the focused beam diameter. The intrinsic material losses at 780 nm of rods 1, 3, and 4 were, respectively, 0.03, 0.04, and 0.035 cm/sup -1/ . These losses are somewhat greater than has been reported, but there is much variability in the quality of the Ti:Al/sub 2/O/sub 3/ material. A unique feature of this study was the determination of the crystal material losses as a function of the position of the pumped filament in the rod. The ratio of high to low intrinsic losses was — 1.5. The authors results on the characterization of Ti:Al/sub 2/O/sub 3/ laser crystals should prove useful in understanding the origin of the intrinsic material losses and in aiding in attempts to produce homogeneous and low-loss Ti:Al/sub 2/O/sub 3/.

1472 **Nd:Cr:GSGG crystals for large slab lasers.** Stokowski, S.E.; Randles, M.A.; Morris, R.C. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550). pp 116 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Gd/sub 3/Sc/sub 2/Ga/sub 3/O/sub 12/ (GSGG) codoped with Cr and Nd is now being grown in 5-in. diam by >6-in. length boules for use in large slab laser systems. This sensitized laser crystal holds the record for efficiency (5% absolute in a 1/4-in. by 3-in. rod laser). The key technical issues in scaling-up Nd:Cr:GSGG crystals for use in slab laser systems are growing large high-quality boules with good slab yield; applying an edge-cladding to suppress amplified spontaneous emission and parasitic oscillations; and finishing the slabs with flat high-strength surfaces. In growing 5-in. diam boules the authors had to overcome three problems: boule spiraling, which is a common occurrence in gallium garnet growth; a 1-μm absorption band, and boule cracking during cool-down. The authors find that boule spiraling is suppressed by adding divalent ions (Ca or Mg) to the melt. On the other hand, tetravalent ions such as Si and Zr stimulate spiral growth. Thus they add Ca to their GSGG melts. However, adding Ca to GSGG causes the 1-μm absorption. They have strong evidence that the 1-μm absorber is Cr/sup 4+/, which is formed in the Nd:Cr:GSGG crystals to charge-compensate divalent Ca. They overcome this problem by adding the redox couple Ce/sup 3+/, Ce/sup 4+/ and annealing the crystal in a reducing atmosphere. This procedure eliminates Cr/sup 4+/. Absorption coefficients below 0.1%/cm are obtained. They used these new developments to produce Nd:Cr:GSGG slabs for average power lasers.

1473 **Optimization of laser slab treatments for high strength and good mechanical durability.** Marion, J.E. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550). pp 116 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Fracture from surface tensile stresses arising from a thermal gradient imposes a fundamental limitation on power output for slab-geometry solid-state lasers. Increased slab strength is desirable to extend this limitation to higher output power. Likewise, an improvement in mechanical durability is desirable to retain slab strength in the presence of the inevitable physical damage encountered in service. Using analytical models, the author examines the various methods available for slab strengthening and for increasing slab mechanical durability to determine the extent of the improvement that one can expect from each process. The author then experimentally assesses the most promising techniques and apply those to actual slabs. This paper details an ongoing effort at Livermore National Laboratory to increase slab strength and mechanical durability. To increase mechanical durability, he finds that thick compressive layers with moderate amounts of compressive stress are most resistant to physical damage. The results are generally confirmed by his experimental measurements on several compressive layers, including thick epitaxial films on crystals and thin ion-beam sputtered films on glass. Both layers improve mechanical durability; substantial physical damage can be resisted without significant deterioration in strength. The thick layers are most durable, and, although the thin layers are less durable, they are still helpful in retaining strength. The author has now started applying these results to improve the strength and durability of full-sized slabs and have begun fracture tests of these slabs in actual laser heads. The author summarizes results for both small specimen testing and full-sized slab fracture tests.

1474 **Prospects for free-electron laser operation in the extreme ultraviolet.** Newman, B.E. (Los Alamos National Lab., Chemistry and Laser Sciences Div., Los Alamos, NM 87545). pp 92 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Continued progress by several research groups is increasing the near-term prospects for free-electron laser (FEL) operation into the extreme UV and soft x-ray regions. For wavelengths longer than 1 nm, these devices hold the promise of greatly exceeding the spectral brightness of the present generation of broadly tunable synchrotron light sources. The author compares the salient features of the FEL oscillator and amplifier configurations which are under active study and development.

1475 **Composite polymer/glass edge claddings for new Nova laser disks.** Powell, H.T.; Campbell, J.H.; Edwards, G.; Frick, F.O.; Gemmell, D.S.; Gim, B.M.; Jancaitis, K.S.; Jessop, E.S.; Kong, M.K.; Lyon, R.E. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550). pp 40 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Large Nd:glass laser disks like those used in Nova require an edge cladding which absorbs at 1 μm. This cladding prevents Fresnel reflections from the edges from causing parasitic oscillations which would otherwise reduce the gain. The original Nova disks had a Cu/sup 2+/-doped phosphate glass cladding which was cast at high temperature around the circumference of the disk. Although the performance of this cladding is excellent, it was expensive to produce. Consequently, in parallel with their efforts to develop Pt inclusion-free laser glass, the authors developed a composite polymer/glass edge cladding that can be applied at greatly reduced cost. Laser disks constructed with the new cladding design show identical performance to the previous Nova disks and have been tested for hundreds of shots without degradation. The new cladding consists of absorbing glass strips which are bonded to the edges of polygonal-rather that elliptical-shaped disks. The bond is made by an —25-μm thick clear epoxy adhesive whose index of refraction matches both the laser and absorbing glass. By blending aromatic and aliphatic epoxy constituents, they achieved an index-of-refraction match within approximately +-0.003 between the epoxy and glass. The epoxy was also chosen based on its damage resistance to flashlamp light and its adhesive strength to glass. The present cladding is a major improvement over a previous experimental cladding utilizing silicone rubber as a coupling agent. Early prototypes constructed without using the presented techniques exhibited failures from both mechanisms. Delamination failures occurred which clearly showed both surface and bulk-mode parasitic oscillation. Requirements on the polymer, disk size, and Nd doping to prevent these problems are presented.

1476 **Progress in higher-average-power solid-state laser development at Lawrence Livermore National Laboratory 1987.** Summers, M.A.; Trenholme, J.B.; Gelinas, R.J.; Stokowski, S.E.; Marion, J.E. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550). pp 114 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Technical Paper WB1.

Over the past two years, the medium-average-power laser program has made substantial progress in developing the technology necessary to demonstrate efficient near-diffraction-limited solid-state lasers. A design methodology, new materials, laser components, and system architectures have been developed for operation at laser power levels in the 100-10 kW range. Many of these technology improvements are being tested on a glass zigzag slab laser which is designed to operate at 150 J/pulse at a repetition rate of 2 Hz. This laser system employs an injection-locked regenerative amplifier cavity architecture incorporating an SBS phase conjugator. The authors believe that beam quality close to the diffraction limit can be achieved by proper slab and laser cavity design. The slab thermal-stress-optic design codes have been experimentally verified at the 2-D level, and the authors have made significant progress toward full 3-D capability. The statistical methods for predicting the fracture of these materials were demonstrated to be in close agreement with observations, and the techniques for slab strength-

ening were extended to improve durability as well. They anticipate that high-average-power harmonic generation can achieve > 80% conversion efficiency for lasers with output powers > 1 GW. The Lawrence Livermore National Laboratory is two years into an aggressive program to develop the board-base technology necessary to realize efficient near-diffraction-limited solid-state lasers operating at the 100-10-kW power level.

1477 **Pulsed power for high power electron-beam pumped lasers.** Buttram, M.T.; Gerber, R.A. (Sandia National Labs., Albuquerque, NM). pp 40-49 of Pulse power for lasers. Burkes, T.R. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870132—). Contract AC04-76DP00789.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

A primary consideration for operation of many high power gas lasers is the generation of a high voltage, large area electron beam. Beam parameters are dictated by laser requirements. Historically the electrical system typically has consisted of a Marx generator with pulse shaping stages of a pulse forming line. In the latter case, one or more high voltage switches (spark gaps) are required. Generally, these systems have been single pulse with cold cathode diodes. For repetitive systems, there is a trend to replace the Marx generator with a pulse transformer. For long pulses and large diode impedances, the pulse shaping elements can be placed in the transformer primary circuit. Otherwise, a PFL and high voltage switch are still required. In either case, issues of beam current uniformly over large areas (including control of pinching) and mitigation of an arc formation must be addressed. This paper will review ongoing work relevant to the electrical systems and beam sources. State-of-the art will be described and a modest attempt will be made to extrapolate current trends.

1478 **Experimental demonstration of a diode laser-pumped atomic rubidium vapor optical filter.** Chung, Y.C.; Dobbins, J.D.; Shay, T.M. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). pp 64 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Technical Paper TUK13.

The authors report the first demonstration of narrow-bandwidth optical filtering in diode laser-pumped Rb vapor. In this experiment, the Rb (5rho/sup 2/P/sub 3/2/) level is populated by a GaAlAs diode laser that is frequency stabilized on the RbD/sub 2/ line. The output power of the diode laser is 8.7 mW. An Ar/sup +/ laser-pumped tunable dye laser is used as an optical test oscillator for the filter. The frequency of the dye laser is scanned through the Rb(5rho-7d) transition line (572 nm). When dye laser photons are absorbed by the excited Rb(5rho) atoms, violet sidelight fluorescence at wavelengths of 421,359, and 335 nm is emitted from the excited Rb vapor and detected by a photomultiplier tube. Thus a laser-induced fluorescence experiment is performed, where diode laser pumping photons and 572-nm dye laser photons are absorbed subsequently in Rb vapor, and then violet photons are emitted. There is no detectable signal on the photomultiplier tube when the dye laser is tuned off from the Rb(5p-7d) transition line line or the diode laser is tuned from the Rb D/sub 2/ line. A complete description of our experiment and the results are presented.

1479 **Flashlamp radiation recycling for enhanced pumping efficiency and reduced thermal load.** Jancaitis, K.S.; Powell, H.T. (to Dept. of Energy). US Patent Application 6-922,424. 23 Oct 1986. 27p. Contract W-7405-ENG-48. DE88000881 NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000881/JAW.

A method for recycling laser flashlamp radiation in selected wavelength ranges to decrease thermal loading of the solid state laser matrix while substantially maintaining the pumping efficiency of the flashlamp.

1480 **Method for laser-based two-dimensional navigation system in a structured environment.** Boultinghouse K.D.; Schoeneman, J.L.; Bertice, L.T. (to Dept. of Energy). US Patent Application 6-919-994. 17 Oct 1986. 28p. Contract AC04-76DP00789. DE88000878 NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000878/JAW.

A low power, narrow laser beam, generated by a laser carried by a mobile vehicle, is rotated about a vertical reference axis as the vehicle navigates within a structured environment. At least three stationary retroreflector elements are located at known positions, preferably at the periphery of the structured environment, with one of the elements having a distinctive retroflection. The projected rotating beam transverses each retroflector in succession, and the corresponding retroreflections are received at the vehicle and focussed on a photoelectric cell to generate corresponding electrical signals. The signal caused by the distinctive retroreflection serves as an angle-measurement datum. An angle encoder coupled to the apparatus rotating the projected laser beam provides the angular separation from this datum of the lines connecting the mobile reference axis to successive retroreflectors. This real-time angular data is utilized with the known locations of the retroreflectors to trigonometrically compute the exact real-time location of the mobile reference axis (hence the navigating vehicle) vis-a-vis the structure environment, e.g., in terms of two-dimensional Cartesian coordinates associated with the environment.

1481 **Single-element optical injection locking of diode-laser arrays.** Hadley, G.R.; Hohimer, J.P.; Owyoung, A. (to Dept. of Energy). US Patent Application 6-916-344. 7 Oct 1986. 27p. Contract AC04-76DP00789. DE88000873 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000873/JAW.

By optically injecting a single end-element of a semiconductor laser array, both the spatial and spectral emission characteristics of the entire laser array is controlled. With the output of the array locked, the farfield emission angle of the array is continuously scanned over several degrees by varying the injection frequency.

1482 **Light-driven phase shifter.** Early, J.W. (to Dept. of Energy). US Patent Application 6-909,746. 19 Sep 1986. 18p. Contract W-7405-ENG-36. DE88000870 NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000870/JAW.

A light-driven phase shifter is provided for modulating a transmission light beam. A gaseous medium such as argon is provided with electron energy states excited to populate a metastable state. A tunable dye laser is selected with a wavelength effective to deplete the metastable electron state and may be intensity modulated. The dye laser is directed through the gaseous medium to define a first optical path having an index of refraction determined by the gaseous medium having a depleted metastable electron state. A transmission laser beam is also directed through the gaseous medium to define a second optical path at least partially coincident with the first optical path. The intensity of the dye laser beam may then be varied to phase modulate the transmission laser beam. 2 figs.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 109, 159, 480, 614, 706, 747, 866, 1196, 1399, 1427, 1653, 2734

1483 **(AD-A—183359/9/XAB) Flow-visualization study of laminar/turbulent transition in a curved channel. Master's thesis.** Siedband, M.A. (Naval Postgraduate School, Monterey, CA (USA)). Mar 1987. 126p. NTIS, PC A07/MF A01.

Laminar/turbulent transition was studied as it occurs in a newly constructed curved channel of rectangular cross section. The channel is 1.27 cm high by 50.8 cm wide, aspect ratio of 40 to 1, with a concave surface radius of curvature of 60.96 cm. Mean velocities for air in the channel range from 1.40 to 3.89 m/sec, which corresponds to Dean number and hydraulic Reynolds number ranges of 167 to 4651 and 2,231 to 6,173, respectively. Flow visualization from a smoke fire shows changes in the behavior and appearance of a smoke trace illuminated in the radial plane with vary-

ing Dean number and varying channel location. In some cases, these smoke trace patterns show distortion similar to what would be expected if pairs of counter-rotating vortices are present. A map of vortex stability as channel location and Dean number were varied was constructed from analysis of smoke trace photographs.

1484 **(DOE/ER/13167—1) Geometric analysis of ensemble of solutions in two-phase flow and complete resolution of problem of choking: Final report, February 1984-April 1987.** Kestin, J. (Brown Univ., Providence, RI (USA). Div. of Engineering). Aug 1987. Contract AC02-84ER13167. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001687/JAW.

The search for choking "criteria" was abandoned in the now completely justified conviction that the onset of choking, and that the appropriate conditions for its occurrence, must be obtained as logical consequences of the mathematical model of the two-phase flow employed by the analyst. Secondly, it was determined that the preponderant majority of mathematical models for steady-state flows (the ones germane to the problem of choking) consist of a number, $n \geq 2$, of nonlinear ordinary differential equations in n unknowns and in a single independent variable - the space coordinate z. Thirdly, it was recognized that the preceding schema dominates the analysis of dynamical systems which have been the subject of intensive and very fruitful mathematical studies. The latter have achieved remarkable progress in the understanding of the nature of the problem and of its handling by topological-geometric methods. The application of these methods to two-phase flow models constitutes the prime achievement of this project; it led to the formulation of an analytic supplement which determines the existence of choking and the location of the critical cross-section.

1485 **(DOE/PC/90962—T4) Experiments on densely-loaded non-Newtonian slurries in laminar and turbulent pipe flows: Quarterly technical progress report No. 4.** Park, J.T.; Mannheimer, R.J.; Grimley, T.A.; Morrow, T.B. (Southwest Research Inst., San Antonio, TX (USA)). 15 Oct 1987. Contract FG22-86PC90962. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000719/JAW.

An experimental description of the flow structure of non-Newtonian slurries in the laminar, transitional, and full turbulent pipe flow regimes is the primary objective of this research. Measurements include rheological characterization of the fluid and local fluid velocity measurements with a laser Doppler velocimeter (LDV). Optical access to the flow is gained through a test section and model slurry which are both transparent. The model slurry is formulated from silica gel particles and hydrocarbon liquid mixture whose indices of refraction are matched so that light is not scattered from the particles. Experiments are being conducted in a large-scale pipe slurry flow facility with an inside pipe diameter of 51 mm (2 inches). Detailed flow measurements including turbulence quantities such as Reynolds stress will be taken with a two-component two-color LDV. The present research indicates that non-Newtonian slurries are possible with concentrations of a few percent by weight of small particles whose sizes are one micron or less. A non-Newtonian slurry from small particles could maintain large particles (100 micron size) at high concentrations in suspension almost indefinitely. Such a slurry would prevent particle fallout and its associated problems. A benchmark pressure-drop experiment with a glycerine and water mixture (a Newtonian fluid) was completed in the pipe slurry facility for pipe Reynolds numbers between 100 and 3500. The pipe friction factor for Hagen-Poiseuille flow was in agreement with theory within experimental error. The transition Reynolds number based upon pipe diameter was 2000, which agrees with the value on the Moody diagram. Preliminary benchmark velocity profile measurements also have been completed in the flow loop. 19 refs., 19 figs., 4 tabs.

1486 **(EIR—625) Contributions to the design and optimization of dry cooling systems of thermal power plants.** Fischer, E.; Reichlin, K.; Ray, A.; Leuenberger, J. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jul 1987. 105p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700110/JAW.

A computer program has been established to calculate the thermal performance of a crossflow heat exchanger as a compound of elemental cross flow cells. This program calculates also the outlet temperature distributions, which are of importance for the fluid flow investigations. Based on the existing Forgo concept with six parallel rows of tubes, possible multi-pass structures for the improvement of thermodynamic performances have been investigated. The results show that a three-pass structure is the best choice. Dry cooling towers equipped with standard and modified Forgo-type cooling elements have been designed. The results indicate that the heights of the cooling towers do not differ much. Fewer cooling deltas are, however, needed in a cooling tower using modified elements with increased fin depth. Consequently the base diameter of the cooling tower will be smaller. The cost of the towers with modified heat exchangers will not necessarily be cheap. Electricity generating cost of a 1000 MW nuclear power plant is also slightly higher, if modified elements instead of standard elements are used. An advanced concept of dry cooling of large-scale nuclear power plants with refrigerants has been investigated. For the cooling of LWR (Light Water Reactor) power plants, ammonia is the most suitable candidate. Ammonia gives a smaller cooling tower than when water is used as coolant. Fluorinated hydrocarbons are not suitable for this application. The cooling of HHT (High Temperature Reactor with Helium Turbine) power plants with refrigerants seems to be promising. Further investigations in this field with ammonia and R11 appear worthwhile.

1487 **(INIS-BR—718) Development of an experimental apparatus for boiling analysis.** Castro, A.J.A. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Engenharia Mecanica). Apr 1984. 146p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703470/JAW.

The nucleate boiling is the most interesting boiling regime for practical applicoations, including nuclear reactor engineering. such regime is characterized by very high heat transfer rates with only small surface superheating. An experimental apparatus is developed for studying parameters which affect nucleate boiling. The following parameters are analysed: pressure, fluid velocity and the fluid temperature at the test section entrance. The performance of experimental apparatus is analysed by results and by problems raised by the oeration of setup.

1488 (N—87-26531, pp vp) **Cellular automaton supercomputing.** Wolfram, S. Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

Many of the models now used in science and engineering are over a century old. And most of them can be implemented on modern digital computers only with considerable difficulty. Some new basic models are discussed which are much more directly suitable for digital computer simulation. The fundamental principle is that the models considered herein are as suitable as possible for implementation on digital computers. It is then a matter of scientific analysis to determine whether such models can reproduce the behavior seen in physical and other systems. Such analysis was carried out in several cases, and the results are very encouraging.

1489 **(SAND—86-1817) NACHOS II: A finite element computer program for incompressible flow problems: Part 2, User's manual.** Gartling, D.K. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 129p. NTIS, PC A07. Order Number DE88001451/JAW.

Complete user instructions are given for the finite element, fluid mechanics and heat transfer code, NACHOS II.

1490 **(SAND—87-1277C) Applications of real-time radiography to rheological characterization and processing dynamics.** Graham, A.L.; Mondy, L.A.; Powell, R.L. (Los Alamos National Lab., NM (USA); Sandia National Labs., Albuquerque, NM (USA); California Univ., Davis (USA)). Sep 1987. Contract AC04-76DP00789. 10p. (CONF-8710144—1). NTIS, PC A02. Order Number DE88000175/JAW.

From JANNAF propellant characterization subcommittee meeting; Laurel, MD, USA (6 Oct 1987).

The combination of real-time radiography, high-speed video recording, and image analysis is used to study the internal dynamics of concentrated suspensions. This technique is used to measure macroscopic rheological properties and to obtain information about the microstructure of highly concentrated suspensions. By measuring the average velocity of a sphere falling through the suspension, the macroscopic viscosity is determined. The fluctuations about the mean velocity have been shown to be more sensitive to microstructural information, such as differences in the shapes and sizes of the suspended particles, the overall volume fraction of the dispersed phase, and particle aggregation. In addition, this technique has been used to observe mass settling of nonneutrally buoyant particles in highly concentrated suspensions. We find that group settling velocities can be over an order of magnitude faster than individual settling velocities. In addition, this technique may be used to follow tracer particles during the processing of highly filled particulate systems.

1491 **(SFB—210/T-24) Possibilities of modelling dynamic loads on cylindrical structures in wind tunnel experiments.** Menacher, F.; Maier-Erbacher, J. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Sonderforschungsbereich 210 Stroemungsmechanische Bemessungsgrundlagen fuer Bauwerke). 1987. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753273/JAW.

The authors investigate dynamic loads on cylindrical structures in natural wind fields using aerodynamic transfer functions. Starting from the theoretical fundamentals, various geometrical structures are investigated, and the possibility of combining a theoretical analysis with a load simulation is gone into. Davenport's method is applied both to the horizontal and the vertical transfer function, and the wind spectrum is calculated. (HAG).

4205 Materials Testing

REFER ALSO TO CITATION(S) 551, 691, 769, 770, 796, 809

1492 **(AD-A—183236/9/XAB) Use of x-rays and neutrons to measure (residual) stress elastic constants. Technical report.** Rudnik, P.J.; Krawitz, A.D.; Reichel, D.G.; Cohen, J.B. (Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science). Jul 1987. 21p. (TR—24). NTIS, PC A02/MF A01.

From this study, one can conclude that, for a sample without a large stress gradient, the diffraction elastic constants should not be dependent upon the radiation source used to measure them. Nor are they dependent upon whether uniaxial tension or four-point bending is used. This is, of course, just a beginning; future experiments must address the effects of a large stress gradient in the sample. This is necessary not merely as a logical next step, but because it is also a more-realistic representation of typical residual stress samples.

1493 **(CEGB-TPRD/B—0856/R86) Application of secondary-ion mass spectrometry to examination of oxides on LWR specimens.** Pick, M.E.; Warner, A.G.; Kelland, M.S. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1986. 52p. (PWR-CWG-P—86-378). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87752841/JAW.

Secondary-ion mass spectra obtained by argon ion bombardment of the radioactive oxides on a range of PWR specimens are presented. The analytical data obtained from the spectra are compared with chemical and electron microscope X-ray analyses of the oxides and relative ion yield data for the major components of the oxide are derived. The results of profiles through the oxides are presented, these show that the oxides appear to be homogeneous rather than having a layer type structure. A number of oxide specimens treated with acid and alkaline potassium permanganate decontamination solutions have also been examined, clear differences in the amounts of manganese dioxide deposited from these solutions are observed. Secondary ion mass spectrometry has been shown to be a useful technique for examination of surface oxides, although some development work is required to provide quantitative information.

1494 **(CONF-8706187—) Proceedings of the fifth symposium on energy engineering sciences: Instrumentation, diagnostics, and material behavior.** (Argonne National Lab., IL (USA)). Jun 1987. Contract W-31109-ENG-38. 271p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88001479/JAW.

From 5. Symposium on energy engineering sciences; Argonne, IL, USA (17 Jun 1987).

Separate abstracts were prepared for the individual papers in this report. (JDB)

1495 **(EGG-SD—7399) Real time x-radiography for examination of remotely handled radioactive objects.** Brown, B.W.; Mikesell, C.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1986. Contract AC07-76ID01570. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001578/JAW.

This study examines the effectiveness of a 420 keV x-ray machine, electron linear accelerators and isotopes as radiation sources utilizing various imaging systems for the examination of intermediate-level radioactive waste products. Although an existing 420 keV radiographic equipment is used for examination of certain low-level waste, it lacks the penetrating power for examination of lead lined drums or drums containing intermediate-level radioactive sludge. Two 55-gal drums containing simulated waste were prepared for the test. Industrial radioactive sources (Co_{60} and Ir_{192}) were used in and on the drum during the imaging tests to serve as concentrated radioactive waste. Evaluations were conducted using radiographic equipment ranging in energy from 420 keV to 11 MeV and five different image detection and processing systems. Results are reported that describe the relative effectiveness of each system, and recommendations for implementation of the technology are included. 13 refs., 10 figs., 4 tabs.

1496 **(N—87-26399) High temperature fatigue and structures testing facility.** Bartolotta, P.A.; Mcgaw, M.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1987. 24p. (NASA-TM—100151; E—3712; NAS—1.15:100151). NTIS, PC A02/MF A01.

To support experimentation, the NASA Lewis Research Center's High Temperature Fatigue and Structures Laboratory has been expanded significantly. Several new materials testing systems have been added, as well as an extensive computer system. The intent of this paper is to present an overview of the laboratory, and to discuss specific aspects of the test systems. A limited discussion of computer capabilities will also be presented.

1497 **(ND-R—1163-S) Ball cratering method for Auger analysis of oxide layers on 20-25-Nb CAGR cladding.** Riley, B.F. (UKAEA Risley Nuclear Power Development Establishment). Nov 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752844/JAW.

A ball cratering method has been developed for the Auger analysis of oxide layers on 20-25-Nb CAGR cladding to overcome the inadequacies of ion etching for producing composition-depth profiles. Besides enabling much faster analysis, the ball cratering method reveals irregularity in the oxide layer structure, eliminates the interface smearing caused by ion etching and enables a determination of the oxide thickness to be made. The method may be extended to the analysis of other specimens, three fundamental geometries (flat, cylindrical and spherical) being considered.

1498 **(ORNL—6408) Pulsed eddy-current inspection of thin-walled stainless steel tubing.** Dodd, C.V.; Koerner, D.W.; Deeds, W.E.; Pickett, C.A. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001492/JAW.

A pulsed eddy-current system has been developed for production inspection of small, thin-wall, non-ferromagnetic tubing. To detect and accurately size both outer and bore-side flaws required

an operating frequency higher than available from present commercial equipment. A pulsed eddy-current instrument was designed and constructed that used 3.2 MHz square waves, with a bandwidth of 20 MHz. The system is able to reliably detect flaws as small as 0.015 mm (0.6 mils) on either the inner or outer surface of the tube. A computer controls the scanning of the tube, as recording, analyzing, and plotting the data. The computer programs and instrument details are given in the report.

1499 **(SAND—87-0632) A comparison of structural frequency response functions measured with forces from 500 to 250,000 lb.** Bateman, V.I. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000668/JAW.

Modal analysis of structural systems is typically performed at low force levels (10's or 100's of pounds). Often, in their intended use environment, the systems encounter much higher service loads, and linearity of their responses must be assumed. This work describes a technique to dynamically characterize structural systems with force levels in excess of 100 klb. A hollow steel bar (6 in. in dia and 60 in. long) was instrumented with strain gages at an axial distance of 41.25 in. A frequency response function for the bar was determined from the strain gage measurements in response to a transient force of a few hundred pounds. A Reverse Hopkinson Bar technique was used to generate a force input at 150 and 250 klb for the same hollow steel bar. A frequency response function was calculated for this high-force input that simulates a field test environment. The two frequency response functions are compared. 4 refs., 15 figs.

1500 **(Y—2357) Computerized certification of digital ultrasonic instrumentation.** Moyer, M.W. (Oak Ridge Y-12 Plant, TN (USA)). 30 Sep 1987. Contract AC05-84OS21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000820/JAW.

A computerized inspection system is being set up at the Oak Ridge Y-12 Plant to enable certification of the Krautkramer Branson ultrasonic instrumentation used extensively in Y-12 production operations. The system takes the data required to certify the linearity and frequency response of the receiver and to certify the correct operation of the pulsers, gates, and computer interface. A subset of the program will be able to verify correct instrumentation in the field by using the actual computer and instrumentation being used for production ultrasonic weld inspections. The system can reduce the certification time from approximately one week to less than an hour. 4 figs., 1 tab.

1501 **Status of stainless steel pipe inspection in the US.** Dau, G.J.; Behravesh, M.M.; Doctor, S.R. (Electric Power Research Inst., Palo Alto, CA, USA; Battelle Pacific Northwest Lab., Richland, WA, USA). *International Journal of Pressure Vessels and Piping:* **28**: No. 1-5, 295-305(1987).

Recent progress made in the inspection of stainless steel piping is summarised. Topics covered include the training of personnel for both detection and sizing of intergranular stress corrosion cracking (IGSCC) found in Boiling Water Reactor piping. The inspection of the weld overlay used to repair pipe joints with IGSCC and inspection of centrifugally cast stainless steel pipe is also addressed. A summary of advanced systems that have satisfied the NRC performance demonstration requirements is also given.

1502 **Methods of and apparatus for levitating and eddy current probe.** Stone, W.J. (to Dept. of Energy). US Patent Application 6-919,166. 1986. 15p. Contract AC04-76DP00613. DE88000877 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000877/JAW.

An eddy current probes is supported against the force of gravity with an air bearing while being urged horizontally toward the specimen being examined by a spring and displaced horizontally against the force of the spring pneumatically. The pneumatic displacement is accomplished by flowing air between a plenum chamber fixed with respect to the probe and the surface of the specimen. In this way, the surface of the specimens can be examined without making mechanical contact therewith while precisely controlling the distance at which the probe stands-off from the surface of the specimen. 4 figs.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 534, 535, 536, 537, 1079, 1278, 1406, 1417, 1445, 1477, 2458, 2775

1503 **(AD-A—182980/3/XAB) Theory and practice of radiation dosimetry in the radiation-hardness testing of electronic devices and systems. Summary report, January-June 1986.** Kerris, K.G. (Harry Diamond Labs., Adelphi, MD (USA)). Apr 1987. 38p. (HDL-TR—2107). NTIS, PC A03/MF A01.

This monograph covers, in condensed form, the essentials of radiation dosimetry as it is applicable to radiation-hardness testing of electronics. An overview of general dosimetry concepts treats absorbed dose and dose rate, charged particle equilibrium, and interface dose enhancement. The most practical techniques for measurement of absorbed dose and dose rate are discussed, both for flash x-ray and cobalt-60 testing. Methods for determining flash x-ray and cobalt-60 spectra are covered briefly. Applications to electronic device testing are discussed with special emphasis on applicable standards. An extensive bibliography is included as an aid for further research.

1504 **(AD-A—183389/6/XAB) Theory of cross-field devices and a comparative study of other radiation sources. Memorandum report.** Lau, Y.Y. (Naval Research Lab., Washington, DC (USA)). 21 Jul 1987. 71p. (NRL-MR—6029). NTIS, PC A04/MF A01.

This paper gives an elementary exposition of the theory of cross-field microwave devices. It provides an examination of the interaction mechanism in the light of the more modern radiation sources such as orbitron, gyrotron, peniotron, and gyomagnetron. The operating conditions of magnetrons are described, together with a qualitative description of the physical processes by which the energy of the electrons is transferred to the rf. These processes involve an interplay of the streaming motion and transverse migration of the electrons in DC electric and magnetic fields, and phase focusing provided by the rf fields of the corrugated walls. The essential features of the interaction mechanism can be quantified by the use of a sheet-beam model and the various radiation sources are then characterized by a single dimensionless parameter (h), which is proportional to the equilibrium electric field experienced by the sheet beam. The wall corrugation enters only in the admittance in the theory of beam-wave interaction. A small signal theory is developed from first principle for general values of h. The decisive dependence of the stability on the equilibrium type (h) is described in detail. While the validity of the simple theory has been ascertained by various vigorous tests, several important features remain to be tested in laboratory experiments. These, together with other outstanding issues, are addressed.

1505 **(EGG-REQ—7771) Operations manual for the Electrical Circuit Characterization and Diagnostic (ECCAD) system.** Edson, J.L.; Dinsel, M.R.; Lebo, M.C. (EG and G Idaho, Inc., Idaho Falls (USA); Bechtel North American Power Corp., Gaithersburg, MD (USA); Advanced Technology Engineering Systems, Inc. (USA)). Jul 1987. Contract AC07-76ID01570. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001534/JAW.

This report describes the operational aspects of the Electrical Circuit Characterization And Diagnostic (ECCAD) system including both Data Acquisition and the ACE Data Analysis package. The purpose is to describe for the user of the ECCAD system the installation, operation, and maintenance of the equipment. The ECCAD system was initially developed and operated by EG and G Idaho, Inc. for the Department of Energy (DOE) to test circuits at TMI-2 that were subjected to the accident. An improved model was subsequently built by EG and G Idaho, Inc., and operated at Duke Power Company's Oconee Nuclear Station as part of a technology transfer program sponsored by the DOE. This operating manual was written to support the improved ECCAD system developed for the technology transfer program.

1506 **(IS—4924) Alternating current circuit theory and pulsed NMR [nuclear magnetic resonance].** Gerstein, B.C. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000641/JAW.

Pulsed NMR, by definition, deals with time varying excitations. These excitations, supplied by "resonant circuits" which provide a pulse of radiofrequency (frequencies in the megahertz region) power to a "resonant circuit" containing, among other things, a coil of wire, or inductor, in which a sample under investigation is placed for purposes of the nuclear magnetic resonance experiment. There are therefore two features of the pulse NMR experiment. First is the fact that we have available a source of continuous wave (CW) alternating current at some angular frequency, ω, measured in radians per second. This source is generally supplied by an ultrastable device called a "frequency synthesizer". The second feature of the pulsed NMR experiment is that the sample is not continuously irradiated, but, a pulse of radiofrequency oscillation is applied to the sample. This report discusses alternating current theory, resonant circuits and the equipment used in this experiment.

1507 **(LA-UR—87-2948) Increased gain of channel intensifier tubes by pulsed biasing.** Noel, B.W.; Cates, M.R.; Franks, L.A. (Los Alamos National Lab., NM (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA). Enrichment Technology Applications Center; EG and G Energy Measurements, Inc., Goleta, CA (USA)). Sep 1987. Contract W-7405-ENG-36. 16p. (CONF-8709139—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000512/JAW.

From 9. symposium on photoelectronic imaging devices; London, UK (7 Sep 1987).

Although the most common use of proximity-focused channel intensifier tubes (CITs) is as optical image amplifiers, electrical gating allows them to be used as fast shutters. Except for gating, however, the effects of imposing transient or pulsed changes on CIT biases have received little attention in the literature. It would be desirable in many applications to attain the maximum possible gain, but not at the expense of reduced signal-to-noise ratio (SNR). In the experiments described here, we used pulsed biasing to increase gain; our measurements show a marked increase in gain over the dc gain without the increase in electronic noise and risk of damage that higher dc potentials create. 7 refs., 4 figs.

1508 **(SAND—85-2757) A preliminary investigation into the use of bulk acoustic wave delay lines as timers for electronic neutron generators.** Rochau, G.E. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001317/JAW.

A preliminary study has been completed examining the use of bulk acoustic wave delay lines as the basis for a precise timer in neutron generator applications. Commercially-available delay lines were incorporated into prototype circuits for evaluation. Preliminary specifications for the SA3281 and SA3282 delay lines were developed and characteristic data for prototype SA3281 devices are presented when used in a circuit incorporating high power MOSFET transistors. A conceptual design is presented for a self-powered timer and recommendations are made for further evaluation. 8 refs., 17 figs., 2 tabs.

1509 **(SAND—87-0419C) Sandia's fault analysis system for non-DFT designs.** Hofstadler, P. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-870986—1-Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87010683/JAW.

From International test conference; Washington, DC, USA (1 Sep 1987).

A toolset is described that is used to do comprehensive fault analysis on Sandia's past, present, and future generation designs. This toolset provides very fast realistic fault simulation at both the gate and switch level, hierarchical fault reporting, and automatic annotation of undetectable faults. The toolset is built around the Mentor Graphics design system and a Mach1000 hardware accelerator from Silicon Solutions. This session describes the work at Sandia National Laboratories' Center for Radiation Hardened Microelectronics (the CRM) in Albuquerque, New Mexico. The CRM designs and manufactures radiation hardened microelectronics for hostile environments. CRM parts are used in satellites, deep space probes, and weapon systems - hence the reliability of these parts must be exceedingly high. Since the yield of a radiation hardened process is inherently low, Sandia must insure high test vector coverage of all detectable faults.

1510 **(SAND—87-1778C) An SEU [single event upset] tolerant memory cell derived from fundamental studies of SEU mechanisms in SRAM [static random access memories].** Weaver, H.T.; Axness, C.L.; McBrayer, J.D.; Browning, J.S.; Fu, J.S.; Ochoa, A. Jr.; Koga, R. (Hughes Research, Carlsbad, CA (USA); Aerospace Corp., Los Angeles, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 18p. (CONF-8707112—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000362/JAW.

From IEEE transaction on nuclear; Snowmass Village, CO, USA (27 Jul 1987).

A new single event upset (SEU) hardening concept, an LRAM cell, is demonstrated theoretically and experimentally. As basis for the LRAM idea, techniques were developed to measure time constants for ion induced voltage transients in conventional static random access memories, SRAM. Time constants of 0.8 and 6.0 nsec were measured for transients following strikes at the n- and p-channel drains, respectively - primary areas of SEU sensitivity. These data are the first transient time measurements on full memory chips and the large difference is fundamental to the LRAM concept. Decoupling resistors in the LRAM are used only to protect against the short transient; longer persisting pulses are blocked by a voltage divider, a basically new concept for SEU protection. In such a design, smaller resistors provide SEU tolerance, allowing higher performance, hardened memories. Test structures of the new design exhibit SEU tolerance with resistors 5-to-10 times smaller than currently used in SRAM. Our advanced transport-plus-circuit numerical simulations of the SEU process predicted this result and account for the LRAM experiments, as well as a variety of experiments on conventional SRAM. 16 refs., 6 figs., 1 tab.

1511 **(SAND—87-1997) Low jitter laser-triggered high-voltage vacuum switch using low laser energies.** Brannon, P.J.; Cowgill, D.F. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001922/JAW.

A laser-triggered high voltage vacuum switch with a unique composite target pellet has been developed. The target pellet is fabricated from a compressed mixture of equal weights of 8-μm titanium and 300-μm KCl powders. The switch triggers reliably for 532-nm laser input energies of 20 μJ corresponding to a peak irradiance of 1 MW/cm^2. Jitter times of less than +- 15 ns are observed. The delay time of the switch increases as the gap voltage decreases. A delay time of less than 100 ns is observed for a gap voltage of 6000 V and a gap spacing of 0.5 mm. The trigger energies and peak irradiances reported here are smaller by an order of magnitude or more than previously reported for laser-triggered vacuum switches.

1512 **(UCRL—15946) An intelligent CCD [Charge Coupled Device] camera control system: Final report.** (Harvey Mudd Coll., Claremont, CA (USA). Engineering Clinic; Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 94p. Harvey Mudd College, Engineering Clinic, Claremont, CA 91711. Order Number TI88000753/JAW.

A Harvey Mudd Engineering Clinic team has designed and constructed an "intelligent" control system for a Charge Coupled Device (CCD) camera, for the Lawrence Livermore National Laboratory. The system hardware constructed by the team consists of three parts. First, a programmable bi-sync generator to control the scanning rate of a camera designed to accept external sync pulses. Secondly, an analog video signal digitizer based on the Burr-Brown ADC600 A/D converter which is capable of 12 bit per pixel resolution at a rate of 10 MHz. Finally, two memory boards for an

IBM PC/XT which can hold a frame of digitized data. Hardware has been installed in the XT which will allow data and commands to be transferred via a GPIB bus. 14 refs., 6 figs.

1513 **Method and apparatus for controlling multiple motors.** Jones, R.G.; Kortegaard, B.L.; Jones, D.F. (to Dept. of Energy, Washington, DC). US Patent 4,689,541. 25 Aug 1987. Filed date 22 Jul 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A motor control system is described for sequentially controlling stepper motors, including: addressing means for generating address data for each motor in a periodic address sequence; memory means responsive to the address data for each motor for accessing a memory location corresponding to the address data, the memory location containing a first data set functionally related to a direction for moving the motor, a number of steps remaining to move the motor, a speed for moving the number of steps, and a rate of change for the speed; first logic circuits for inputting the first data set and for outputting a second data set for commanding the motor to make a single step in a determined direction after a number of the periodic addresses; second logic circuits for inputting the second data set and for outputting a third data set functionally related to a status of the motor is response to the second data set; and means for replacing the first data set with the third data set in the memory at the location corresponding to the address of the motor, the third data set becoming the first data set at a next periodic addressing of the motor.

1514 **Remote reset circuit.** Gritzo, R.E. (to Dept. of Energy, Washington, DC). US Patent 4,686,526. 11 Aug 1987. Filed date 12 Sep 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A remote reset circuit is described for remotely resetting a digital system, the remote reset circuit accepting a receiver data (RxD) signal and generating a reset signal upon receiving the correct RxD reset signal, the remote resetting circuit comprising in combination: adjustable one-shot means triggered by the RxD signal for providing a timed pulse output long enough in duration to permit the clocking in of a desired number of bits transmitted at a predetermined baud rate from the source of the RxD signal; timing means triggered by the timed pulse output of the adjustable one-shot means for providing a synchronous clock signal (Tsync); counting means triggered by the Tsync clock signal for counting the desired number of bits clocked in from the source of the RxD signal; means for presetting a desired reset pattern of bits; means for comparing the bits in the desired number of bits clocked in from the source of the RxD signal with the desired reset pattern of bits and for providing a match signal when the desired number of bits clocked in from the source of the RxD signal compares in pattern with the desired reset pattern of bits; and means for generating a signal to reset the digital system upon receipt of the match signal from the means for comparing.

1515 **Device for providing a circuit with resistive and capacitive characteristics where the resistive characteristic is controllable by electromagnetic radiation.** DeVore, T.M. (to Dept. of Energy). US Patent Application 6-003,524. 15 Jan 1987. 14p. Contract AC08-83NV10282. DE88000858 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000858/JAW.

A dielectric body composed of mercuric iodide is placed between and in contact with two capacitor plates. Electrical conductivity of mercuric iodide increases with the intensity of light on the dielectric body. The dielectric body then forms a resistive path between the two capacitor plates. The two plates and the dielectric body therefore form the circuit equivalent of a capacitor in parallel with a resistor, where the resistance of the resistor is that of the dielectric body. The resistance of the body may be controlled by controlling the intensity of incident light. Charges on the capacitor plates may be discharged by illuminating the body with light of adequate intensity. 4 figs.

1516 **Theoretical analysis of a rotating-disk chemical vapor deposition reactor.** Coltrin, M.E.; Breiland, W.G.; Evans, G.H.; Kee, R.J. New York, NY; American Institute of Chemical Engineers (1987). 5p. (CONF-870323—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From American Institute of Chemical Engineers spring national meeting; Houston, TX, USA (29 Mar 1987).

Technical Paper 55A.

The rotating-disk CVD reactor can be used to deposit thin films in the fabrication of microelectronic components. Computational solutions of the Navier-Stokes equations are used to determine the optimal operating conditions of the rotating disk reactor. Fortunately in most CVD processes the active gases that lead to deposition are present in only trace amounts in a carrier gas. Since the active gases are present in such small amounts, their presence has a negligible effect on the flow and the heat transfer in the carrier. Thus, for the purposes of determining the effects of buoyancy and confinement, the simulations can model the carrier gas alone (or with simplified chemical reaction models) - a substantial reduction in the problem size.

1517 **Methods of determining thin film stress for optical data storage.** Thomas, N.L. (Lawrence Livermore National Lab., Livermore, CA). pp 140-141 of Proceedings of a topical meeting on optical data storage (Summaries). Washington, DC; Optical Society of America (1987). (CONF-8703130—).

From 4. topical meeting on optical data storage; Stateline, NV, USA (11 Mar 1987).

Thin film stress plays an important role in the manufacture of optical data disks which have a rather low aspect ratio and are very susceptible to deformation. The stress parameter is shown to be adjustable by varying deposition parameters. More recently, ion assisted reactive evaporation is a deposition technique which has been shown to be useful in controlling stress. The successful application of these techniques requires that the stress be monitored in situ during the coating process, or by means of a stress monitor disk which is piggy-backed in the coating run and measured afterward, or on a sample data disk from the coating run. Several stress measurement techniques are mentioned in this paper. Intrinsic thin film stress can be determined for single layer films or for multilayer films using any of these techniques. A technique for predicting multilayer stress from individual film stresses is presented. The net stress of a stack of tensile and compressive films as a function of layers are presented. Some data are presented on thin film stress versus deposition parameters.

1518 **High speed data compactor.** Baumbaugh, A.E.; Knickerbocker, K.L. (to Dept. of Energy). US Patent Application 6-947,925. 30 Dec 1986. 20p. Contract AC02-76CH03000. DE88000855 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000855/JAW.

A method and apparatus for suppressing from transmission, non-informational data words from a source of data words such as a video camera. Data words having values greater than a predetermined threshold are transmitted whereas data words having values less than a predetermined threshold are not transmitted but their occurrences instead are counted. Before being transmitted, the count of occurrences of invalid data words and valid data words are appended with flag digits which a receiving system decodes. The original data stream is fully reconstructable from the stream of valid data words and count of invalid data words. 2 figs.

1519 **Phenolic dyes as nonbleachable absorbers compatible with novolac resins for linewidth control in photoresists.** Renschler, C.L. (to Dept. of Energy). US Patent Application 6-934,976. 25 Nov 1986. 12p. Contract AC04-76DP00789. DE88000844 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000844/JAW.

Photoresist techniques and compositions are provided employing curcumin as an absorptive dye for the purpose of reducing linewidth non-uniformity caused by scattered and reflective light from the substrate-resist interface. The photoresist compositions containing curcumin as the absorptive dye are used in the produc-

tion of microelectronic circuitry by both single layer and multilayer photoresist techniques.

1520 **Piezoelectric shear wave resonator and method of making same.** Wang, Jin S.; Lakin, K.M.; Landin, A.R. (to Dept. of Energy). US Patent Application 6-913,192. 30 Sep 1986. 37p. Contract W-7405-ENG-82. DE88000872 NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000872/JAW.

An acoustic shear wave resonator comprising a piezoelectric film having its C-axis substantially inclined from the film normal such that the shear wave coupling coefficient significantly exceeds the longitudinal wave coupling coefficient, whereby the film is capable of shear wave resonance, and means for exciting said film to resonate. The film is prepared by deposition in a dc planar magnetron sputtering system to which a supplemental electric field is applied. The resonator structure may also include a semiconductor material having a positive temperature coefficient of resonance such that the resonator has a temperature coefficient of resonance approaching 0 ppM/°C. 16 figs.

1521 **Digitally programmable signal generator and method.** Priatko, G.J.; Kaskey, J.A. (to Dept. of Energy). US Patent Application 6-902,843. 2 Sep 1986. 21p. Contract W-7405-ENG-48. DE88000865 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000865/JAW.

A digitally programmable signal generator (DPSG) and method are disclosed. The DPSG can be used in applications such as Atomic Vapor Laser Isotope Separation (AVLIS) to create an optimal match between the process laser's spectral profile and that of the vaporized material. Other applications include optical telecommunications, non-optical telecommunication in the microwave and radio spectrum, radar, electronic countermeasures, high speed computer interconnects, local area networks, high definition video transport and the multiplexing of large quantities of slow digital memory into high speed data streams. This invention extends the operation of DPSGs into the GHz range, while preserving all of the current art's DPSGs' operational features.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 145

1522 (ANL/CNSV-TM—173, pp 6-32) **Mass burning: do in-place systems work?.** Borchardt, F.A.; Gesell, G.H. (HDR Techserv, Inc., Omaha, NE). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

Mass-burn waste-to-energy plants take the solid waste as received and burn it as fuel on one of variety of grate types. Depending on their size, the plants may have a tipping floor and a front-end loader or a refuse pit and cranes for storing and handling the waste. Field-erected furnaces, used for large-scale facilities, may either have a refractory furnace chamber and separate boiler or a waterwall furnace and boiler. Modular units, used for smaller-scale facilities, typically have a refractory combustion chamber and are somewhat less efficient. Mass-burn facilities have experienced problems in such areas as receiving and storing of wastes, refuse cranes, grates, boiler tubes, slagging, and ash handling. Effective solutions have been found for these problems, however, and most facilities have been very successful.

1523 **An energy-integrated farm plan for Puerto Rico.** Alexander, A.G. (Center for Energy and Environment Research, Univ. of Puerto Rico, PR). pp 1-27 of Proceedings of the 2nd national conference on renewable energy technologies. San Juan, PR; Center for Energy and Environmental Research (1983). (CONF-8308231—).

From 1. Pan American conference on energy and 2nd national conference on renewable energy technologies; San Juan, Puerto Rico (1 Aug 1983).

A design and operations analysis has been prepared for an energy-integrated dairy farm on Puerto Rico's semi-arid south coast. The energy integration system has two functions: (a) To produce green feed, electricity, and high-protein feed substitutes from manure, and (b) to establish a waste-management system in compliance with local environmental quality regulations. The integrated complex consists of eight subsystems. These include manure preparation and blending, biogas generation, biogas utilization, solids dewatering and drying, wastewater cleaning in algae and fish ponds, wastewater recycling, and green feed production in the form of heavily-manured napier grass. System design and installation costs are estimated at about $600,000. Annual operations costs are placed at $55,000 and annual benefits at about $150,000. A waste management value of $48,000/annum is also credited to the operational system. As an energy-and-feed-producing enterprise the system's payback time is about 6.1 years. With waste management values included the payback time is estimated at 4.1 years. Project funding in the order of $830,000 is provided by DOE and the PR Energy Office. Installation time is estimated at 18 to 24 months.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 160, 191, 522

1524 (DOE/PC/79650—T40) **CWS [coal-water-slurry]-fired residential warm-air heating system: Preliminary component design package: Topical report.** (TECOGEN, Inc., Waltham, MA (USA)). Aug 1987. Contract AC22-87PC79650. 35p. (TE—4415-152-87). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000737/JAW.

Preliminary designs of prototype components of the coal-water-slurry (CWS)-fired residential warm-air furnace have been completed and are described. These components include those promoting combustion processes and those directly related to combustion (such as the combustion chamber, burner, and atomizer), the heat exchanger/boiler, and a gas-cleanup system. A flowtrain incorporating these components was developed to ensure that overall furnace performance goals are reached. Within this flowtrain basic and alternative designs of each component were specified. An Inertial Reactor with Internal Separation (IRIS) was chosen as the primary combustion concept. The IRIS combustor uses some features of cyclone-type reactors to achieve high combustion efficiency. An effective axial-recirculation technique was also shown to increase carbon burnout, and has been adopted as the alternative combustor design. Because of a lack of experimental data on CWS burners this size (i.e., 1000,000 Btu/hour), proof-of-concept testing is being carried out to verify certain design parameters, among which is the necessity of axial recirculation. Two heat-exchange methods - shell-and-tube and finned-tube - were designed as part of Task 1.40. Heat-transfer analyses indicated that either technique could transfer heat from the combustion gases produced by the combustor to the circulating water loop, but a lack of applicable data on fouling in the residential-furnace environment motivates proof-of-concept testing of both types of heat exchanger. 8 figs., 1 tab.

1525 (N—87-25552) **Advanced high temperature static strain sensor development. Final report.** Hulse, C.O.; Stetson, K.A.; Grant, H.P.; Jameikis, S.M.; Morey, W.W.; Raymondo, P.; Grudkowski, T.W.; Bailey, R.S. (United Technologies Research Center, East Hartford, CT (USA)). Aug 1986. 205p. (NASA-CR—179520; NAS—1.26:179520; R—86-995875-28). NTIS, PC A10/MF A01.

An examination was made into various techniques to be used to measure static strain in gas turbine liners at temperatures up to 1150 K (1600 F). The methods evaluated included thin film and wire resistive devices, optical fibers, surface acoustic waves, the laser speckle technique with a heterodyne readout, optical surface image and reflective approaches and capacitive devices. A preliminary experimental program to develop a thin film capacitive device was dropped because calculations showed that it would be too sensitive to thermal gradients. In a final evaluation program, the laser speckle technique appeared to work well up to 1150 K when it was used through a relatively stagnant air path. The surface guided acoustic wave approach appeared to be interesting but to require too much development effort for the funds available. Efforts to develop a FeCrAl resistive strain gage system were only partially successful and this part of the effort was finally reduced to a charac-

terization study of the properties of the 25 micron diameter FeCrAl (Kanthal A-1) wire. It was concluded that this particular alloy was not suitable for use as the resistive element in a strain gage above about 1000 K.

1526 (NP—8750427) **Pressurized fluidized bed fired boiler in the cogeneration plant of the Technical University of Aachen. Plant description and first results. Final report.** Wedel, G. von; Pitt, R.U. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Waermeuebertragung und Klimatechnik; Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Dampf- und Gasturbinen; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Oct 1986. 99p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750427/JAW.

In the cogeneration plant of the Technical University of Aachen, FRG, a pressurized fluidized bed fired boiler of 40 MW thermal power has been installed. This is the first commercial unit of its kind. Due to the air being supplied to the combustor by a turbocharger followed in series arrangement by an electrically driven compressor the load can be varied between 6,5 and 50 metric tons/h of steam with a floating combustor pressure. A hydraulic coal feeding system was chosen. The stack gas is cleaned in a cartridge type filter made of a stainless steel material prior to be expanded in the turbocharger turbine. A survey is given on the concept, the design data and the actual arrangement of the most relevant system components. Additional equipment for further scientific investigation was installed. As a result of experiences during the commissioning phase the solids transport systems have been ammended. Successful operation is expected during the heating period 86/87. With 8 refs., 2 tabs., 31 figs.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 1802, 1998, 1999, 2000

1527 (NAGRA-NTB—81-11) **Stripa Project. Equipment for hydraulic testing.** Jacobsson, L.; Norlander, H. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jul 1981. 16p. Nagra, CH-5401 Baden, Switzerland.

Hydraulic testing in boreholes is one major task of the hydrogeological program in the Stripa Project. A new testing equipment for this purpose was constructed. It consists of a downhole part and a surface part. The downhole part consists of two packers enclosing two test sections when inflated; one between the packers and one between the bottom packer and the bottom of the borehole. A probe for downhole electronics is also included in the downhole equipment together with electrical cable and nylon tubing. In order to perform shut-in and pulse tests with high accuracy a surface controlled downhole valve was constructed. The surface equipment consists of the data acquisition system, transducer amplifier and surface gauges. In the report detailed descriptions of each component in the whole testing equipment are given.

1528 (NAGRA-NTB—81-12) **Stripa Project. Part I: Core-logs of borehole V1 down to 505 m.** Carlsson, L.; Olsson, T.; Stejskal, V. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jul 1981. 30p. Nagra, CH-5401 Baden, Switzerland.

In the hydrogeological program of the Stripa project the vertical borehole V1 has been drilled 505.5 m. The drill-core has been logged with regard to rock characteristic, fracture frequency, dipping and filling. The results presented as cumulative fracture diagram have formed the base for subdivision of the borehole according to fracture frequency. The variation in the fracture dipping was also taken into account. Chlorite is the most common of the infilling material in the fractures. For the borehole 0 -466 m the average fracture frequency is 1.46 fractures/m. Below 466 m the core is highly fractured and crushed indicating that the borehole has entered a crushed zone. Because of this the drilling is temporarily stopped.

1529 (NAGRA-NTB—81-12) **Stripa Project. Part II: Measurement of triaxial rock stresses in borehole V1.** Strindell, L.; Andersson, M. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jul 1981. 13p. Nagra, CH-5401 Baden, Switzerland.

The investigation was performed December 16-18, 1980 and February 2-5, 1981 by Lars Strindell and Mats Andersson, Swedish State Power Board. The drilling was carried out by Hagby Bruk, Nora. One of the tasks within the project is to drill a vertical hole with a diameter of 76 mm to 1050 meters depth. The drilling is performed from a place in the mine at about 360 m below ground level. Hydrologic investigations will be performed in the borehole and knowledge about the existing rock pressure will aid the interpretation of the hydrology data. The intention was to perform 4 measurements at depth of 150, 300 and 450 m respectively. At present, measurements have been carried out at 150 and 300 m depth. At 450 m the quality of the rock was too poor to allow any measurements. The drilling has been interrupted at 506 m depth but the plan is to continue when the borehole has been stabilized along the highly fractured zone. At 150 m the average stresses in the horizontal plane is about 25 MPa in E-W direction and about 20 MPa in the N-S direction. In the region just below 300 m the average stresses is about 20 MPa in the NE-SW direction and about 12 MPa in NW-SE direction. The average vertical stress at 150 m depth is 13.5 MPa and this is in good agreement with the theoretical value. At 300 m the vertical stress is about 13.8 MPa which is somewhat lower than the theoretical value.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 212

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 664, 665, 666, 667, 668, 669, 1706

1530 (EPRI-CS—5361-Vol.2, pp 48.1-48.10) **Nitrogen oxide emissions reduced from cement kiln exhaust gases by process modification.** May, M.S.; Croom, J.M.; Phillips, J.C.; MacMann, R.; Young, G.L. (Professional Services and Management, Dallas, TX). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

In January 1982 the South Coast Air Quality Management District (SCAQMD), El Monte, California, adopted a rule to reduce emissions of nitrogen oxides (NO/sub x/) from the exhaust gases of portlant cement kilns in the South Coast Air Basin. The rule was drafted to allow the cement manufacturers to demonstrate through research whether or not NO/sub x/ could be reduced by modification of the cement manufacturing process. Riverside Cement Company, as a result of review of the literature and pilot studies conducted by KVB, Inc., selected the following four tactics as having potential for reducing NO/sub x/ emissions. These are: (1) reduce the quantity of fuel used per ton of clinker; (2) reduce the quantity and temperature of the primary air; (3) control of the configuration of the flame and (4) improve control of the operation of the kiln. The Riverside Cement Company was able to demonstrate with statistical confidence that the NO/sub x/ emissions, after the implementation of the four tactics for the cement manufacturing process, were 26% less than the pre-modification emissions.

1531 (EPRI-CS—5361-Vol.2, pp 49.1-49.7) **NOx formation in a cement kiln: regression analysis.** Croom, J.M.; May, M.S.; Phillips, C.; Young, G.L.; MacMann, R. (Quantitative Applications, Inc., Stone Mountain, GA). Aug 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920502/JAW. (CONF-870328—Vol.2).

From Joint EPRI/EPA symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

NOx emissions from a cement kiln were analyzed with stepwise linear regression. The goal was to demonstrate which operat-

ing variable(s) control the rate of NOx emissions. Of 14 independent variables in the regression analysis, burning zone temperature of the kiln was the only significant variable; it accounted for 83% of the variability in NOx emissions. Because the burning zone required for production of acceptable quality clinker averages between 2400-2600 F, minimum NOx emission from a long, dry cement kiln is probably 5-6 pound of NOx per ton of clinker produced.

1532 **Sintered composite medium and filter.** Bergman, W. (to Dept. of Energy, Washington, DC). US Patent 4,687,579. 18 Aug 1987. Filed date 2 May 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A filter media is described comprising a sintered composite of quartz fibers and stainless steel fibers having a filter efficiency of at least about 99.99% for 0.3 micron diameter particles, an operative temperature up to about 550°C, and flow resistance comparable to and tensile strength at least four times that of a standard high efficiency particulate air filter media.

43 PARTICLE ACCELERATORS

1533 **(LBL—23833) The role of basic research in society.** Seaborg, G.T. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 10p. (CONF-8707116—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000459/JAW.

From Conference on the superconducting super collider; Berkeley, CA, USA (30 Jul 1987).

This report contains general remarks on the rate of accelerators, especially the Superconducting Super Collider, in the advancement of modern scientific knowledge. (LSP)

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 1580, 2495

1534 (BNL—52082, pp 23-25) **Antiproton production.** Lazarus, D.M. 7 May 1987. NTIS, PC A05/MF A01. Order Number DE87012851/JAW. (CONF-8608192—; AGS/EP/S—87-1).

From Summer workshop on antiproton beams in the 2-10 GeV/c range; Upton, NY, USA (18 Aug 1986).

The results for the antiproton momentum spectrum produced in proton reactions on lead at the CERN Antiproton Accumulator is scaled to AGS operating conditions using the Sanford-Wang formula with no correction for target material. Yield predictions as a function of momentum are shown for 28.3 GeV protons on beryllium and results are converted to antiproton beam flux. The AGS Medium Energy Separated Beam has a flux which is a factor of 2 lower than Sanford-Wang predictions. This may be due to factors affecting beam acceptance.

1535 (BNL—52082, pp 26-43) **Time separated anti p beam.** Brown, H.N. 7 May 1987. NTIS, PC A05/MF A01. Order Number DE87012851/JAW. (CONF-8608192—; AGS/EP/S—87-1).

From Summer workshop on antiproton beams in the 2-10 GeV/c range; Upton, NY, USA (18 Aug 1986).

In 1974, Fainberg and Kalogeropoulos measured the time structure of a resonant extracted beam from the AGS with the RF kept on the maintain tight bunching. The external pulses were found to be unexpectedly narrow (FWHM = 2.4 nsec after correction for counter resolution). An explanation for this and some pertinent comments were put forth by Barton in a subsequent report. The original motivation for the study was to examine the extent to which single counter time of flight (TOF) measurements would be feasible, making it possible to measure velocities of neutral secondary particles from a target. The encouraging result led later to a proposal by Kalogeropoulos to use the tightly bunched protons to produce a secondary time separated beam (TSB) of anti-protons, i.e., a beam with a long flight path over which the lower velocity particles (anti p's) separate longitudinally from the more numberous fast particles (π's) so that the anti p interactions can be studied independently by suitably gated detectors. Production and transport of such a beam is described.

1536 (BNL—52082, pp 62-75) **Overview of booster anti p potential.** Peaslee, D.C. 7 May 1987. NTIS, PC A05/MF A01. Order Number DE87012851/JAW. (CONF-8608192—; AGS/EP/S—87-1).

From Summer workshop on antiproton beams in the 2-10 GeV/c range; Upton, NY, USA (18 Aug 1986).

The accompanying studies describe a specific arrangement whereby the proposed AGS Booster can be employed in a parasitic mode to provide an external beam of 2-6 GeV/c antiprotons whenever the AGS operates in the slowly extracted beam mode and is not running polarized protons or heavy ions. This possibility of continuous production, combined with the favorable operating record established by the AGS, can provide an antiproton source unmatched by any other in that momentum range. This conclusion, at first perhaps surprising, is documented here.

1537 **(CERN-EP—87-95) Physics and detectors at the Large Hadron Collider and at the CERN Linear Collider.** Amaldi, U. (European Organization for Nuclear Research, Geneva (Switzerland)). 25 May 1987. 31p. (CONF-870180—2). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900052/JAW.

From Workshop on physics at future accelerators; La Thuile, Italy (7 Jan 1987).

The paper contains the summary talk given at the workshop on Physics at Future Accelerators. The main topics covered in this paper are: Large Hadron Collider (LHC) and CERN Linear Collider (CLIC) parameters; extrapolation of known physics to the LHC and CLIC, physics targets and achievable limits, detectors, and the interface between accelerators and detectors. 25 refs. (LSP)

1538 (CONF-8605182—, pp 215-230) **SSC developments.** Stork, D.H. (Univ. of California, Los Angeles). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

In less than four years the Superconducting Super Collider (SSC) project has gone from the initial realization that 40 TeV collisions were feasible to the present serious consideration for multibillion dollar funding by the Dept. of Energy (DOE). The author here trace this remarkable history and project it to its central place in high energy physics in the 1990's. The author described the Conceptual Design Report which defines the SSC as it is presently envisioned. Finally the author reviewed recent task force studies of SSC detector development and summarize recent workshop conclusions on the physics capabilities of the SSC.

1539 **(GANIL-A—86-04) Power supply control protocol used at GANIL.** Prome, M.; Baumgarten, R.; Luong, T.T. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752690/JAW.

This document intends to establish specifications for power supply control so that, if complied with by power supply manufacturers, power supplies from any manufacturer can be linked at once to the GANIL Control system. The only points to take care of are reduced to physical link and filling of the data base.

1540 **(GANIL-A—86-05) Status report on GANIL.** Chabert, A. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752691/JAW.

The performances of GANIL are in constant progress and some special equipments are now installed which give a great operation flexibility. Moreover we now routinely accelerate ions from an external ECR source. We first report on these two aspects. Then we will shortly describe two of our main experimental equipments namely the "SPEG" spectrometer and the "LISE" beam line both used in particular for exotic beam production and analysis. We will conclude, mentioning the funded GANIL improvements: "2.5" transformation and "SME" beam line.

1541 **(GANIL-A—86-10) Project "OAE" at GANIL, a project for increasing the heavy ion energies.** Ferme, J. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Oct 1986. 8p. (CONF-8610173—19). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752693/JAW.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

GANIL is composed of three cyclotrons connected in series, with a stripper located between the last two stages. The general parameters have been chosen to fit the characteristics of the PIG ion source. With the advent of ECR sources, which can produce efficiently ions of higher charge state, an optimization of the system has been considered which will result in an increase of the energy range of medium and heavy ions. A few modifications of the machine are necessary and should be carefully prepared so as to minimize the duration of the shut-down planned at the beginning of 1989. Moreover, a systematic study of the axial injection of the first cyclotron has been undertaken in order to improve the intensity of the injected beam with respect to space charge.

1542 **(INIS-BR—844) Dosimetry and monitoring of thin X-ray beam produced by linear particle accelerator, for application in radiography.** Campos, J.C.F. de. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1986. 83p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703740/JAW.

The dosimetry and monitoring characteristics of thin X-ray beams, and the application of 4MeV linear particle accelerator to radiosurgery are studied. An addition collimation system, consisted of 3 lead collimators, which allows to obtain thin beams of 6,10 and 15 mm of diameter, was fabricated. The stereo taxic system, together with modifications in dispositives, provide the accuracy required in volum-targed location. The dosimetric informations were determined with silicon detector inserted into water simulator. The isodose curves for each beam, and total isodoses simulating the treatment were established using radiographic emulsions in conditions which reproduce real circunstances of pacient irradiation. (M.C.K.).

1543 **(LA-UR—87-3313) An Advanced Hadron Facility: Prospects and applicability to antiproton production.** Goldman, T. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 33p. (CONF-8710125—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000479/JAW.

From 2. Rand antiproton conference; Santa Monica, CA, USA (6 Oct 1987).

An Advanced Hadron Facility is designed to address physics problems within and beyond the Standard Model. High fluxes of secondary beams are needed for the requisite precision tests and searches for very rare decay modes of mesons and baryons. Such high fluxes at useful secondary energies are readily obtained from high intensity, intermediate energy proton beams, which are also well suited to antiproton production. If the AHF primary proton beam were merely dumped into a beam stop, it would produce on the order of 10^{19} to 10^{20} antiprotons per operating year. Current collection techniques are not likely to be capable of absorbing more than one part in 10^3 of this production. Thus, an AHF provides both the immediate possibility of collecting quantities of antiprotons substantially beyond those available from the LEF discussed at this meeting, and for significant increases in the available antiproton supply upon the development (at an AHF) of more efficient collection methods. The prospects are presently good for the completion of an AHF in the late 1990's.

1544 **(LBL—23604) A creep measurement of unidirectional epoxy-fiberglass rod.** Munshi, N.A.; Wolgast, R.C. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 8p. (CONF-8706125—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014812/JAW.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

A creep measurement was made to prove the capability of a unidirectionally reinforced, epoxy-fiberglass rod to hold stable dimensions in compression over a 10 year period, during which operating temperatures of 40°C (104°F) could occur. This material has a high modulus of elasticity in tension and compression (~6×10^6 psi) and strengths in excess of 100,000 psi. Its high strength and low thermal conductivity in the range from 300K to cryogenic temperatures make it ideally suited for cryogenic supports. The sample was tested in compression at 52 MPa (7500 psi) at 40°C for 1000 hours. The measured fractional deflection due to creep after 1000 hours was 3×10^{-5}. Extrapolation of the data to 10 years under the test load of 52 MPa predicts a fractional deflection of 6×10^{-5}. The low stress level was appropriate to a conservative design for the dipole magnet support struts for the Superconducting Super Collider cryostat (alternate design), an application requiring long-term accurate positioning of the magnet. The struts carry the weight of the magnet, at liquid helium temperature, to the base at ambient temperature. An elevated ambient standby or storage temperature is the critical temperature for creep deflection in this case. 5 refs., 6 figs.

1545 **(N—87-26173, pp vp) High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility.** Cross, J.B.; Spangler, L.H.; Hoffbauer, M.A.; Archuleta, F.A.; Leger, L.; Visentine, J. (Los Alamos National Lab., NM). Jun 1987. NTIS, PC A09/MF A01. (NASA-CR—181163; JPL—87-14; NAS—1.26:181163; CONF-8611131—).

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

An atomic oxygen exposure facility has been developed for studies of material degradation. The goal of these studies is to provide design criteria and information for the manufacture of long life (20 to 30 years) construction materials for use in LEO. The studies that are being undertaken using the facility will provide: absolute reaction cross sections for use in engineering design problems; formulations of reaction mechanisms; and calibration of flight hardware (mass spectrometers, etc.) in order to directly relate experiments performed in LEO to ground based investigations. The facility consists of: (1) a CW laser sustained discharge source of O atoms having a variable energy up to 5 eV and an intensity between 10(15) and 10(17) O atoms s(-1) cm(-2); (2) an atomic beam formation and diagnostics system consisting of various stages of differential pumping, a mass spectrometer detector, and a time of flight analyzer; (3) a spinning rotor viscometer for absolute O atom flux measurements; and (4) provision for using the system for calibration of actual flight instruments. Surface analysis equipment is available for the characterization of material surfaces before and after exposure to O atoms.

1546 **(SAND—87-2347C) RADLAC-II upgrade.** Shope, S.L.; Frost, C.A.; Hasti, D.E.; Leifesti, G.T.; Mazarakis, M.G.; Smith, D.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-8709146—7). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000929/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

RADLAC-II is a linear induction accelerator that produces a 15-MeV, 15-kA, relativistic electron beam (REB). The accelerating gaps are of a unique design that minimizes gap-induced radial oscillations. An upgrade of the accelerator is in progress that will utilize four Marx generators, four HERMES-III intermediate storage capacitors (ISC), and PEFA-II Rimfire switches. The upgrade is designed to produce a 20-MeV, 40-kA, 1.1-cm radius electron beam. 7 refs., 5 figs.

1547 **(SLAC-PUB—4367) The SLAC Linear Collider: A status report.** Richter, B.; Stiening, R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1987. Contract AC03-76SF00515. 8p. (CONF-870797—2). NTIS, PC A02. Order Number DE88000705/JAW.

From International symposium for lepton and photon interactions at high energy; Hamburg, F.R. Germany (27 Jul 1987).

This report presents progress made at the Stanford Linear Collider (SLC). Design goals of the various components are compared to measurements made on the equipment. 8 figs., 2 tabs. (JDH)

1548 **(SLAC-PUB—4421) Status of the SLC.** Seeman, J.T.; Sheppard, J.C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1987. Contract AC03-76SF00515. 12p. (CONF-8706147—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000701/JAW.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

The construction project for the SLAC Linear Collider (SLC) was officially completed in April 1987, following a successful test in March of passing 46-GeV positron and electron beams through the collider hall on the same accelerator pulse. Since that time, commissioning of the SLC has concentrated on making the stability, intensity and transverse dimensions of both beams suitable to generate useful luminosity near the center of mass energy of 93 GeV. 11 refs.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 1576, 1585, 2248, 2495, 2678

1549 **(BNL—40209) Non-resonant field generation.** Aronson, S.H. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 12p. (CONF-8706147—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014908/JAW.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

Production of fields for particle acceleration by pulse technology is reviewed. Special attention is focussed on several recently proposed schemes for generation of very high gradients, both in metallic structures and plasmas. Ongoing and planned experimental activities in these areas are discussed. 24 refs., 6 figs., 5 tabs.

1550 (BNL—52082, pp 49-50) **Beam momentum resolution.** Glenn, J.W. III. 7 May 1987. NTIS, PC A05/MF A01. Order Number DE87012851/JAW. (CONF-8608192—; AGS/EP/S—87-1).

From Summer workshop on antiproton beams in the 2-10 GeV/c range; Upton, NY, USA (18 Aug 1986).

A brief analysis of the factors affecting antiproton beam momentum resolution is presented. Bending angle, beam emittance, and focusing elements are considered. Production target size is also discussed.

1551 (BNL—52082, pp 51-58) **High field properties of the AGS booster dipole magnet.** Danby, G.T.; Jackson, J.W. 7 May 1987. NTIS, PC A05/MF A01. Order Number DE87012851/JAW. (CONF-8608192—; AGS/EP/S—87-1).

From Summer workshop on antiproton beams in the 2-10 GeV/c range; Upton, NY, USA (18 Aug 1986).

Various aspects of the design and use of the AGS booster dipole magnet are discussed. The original design criteria and choices are outlined and possible additional uses for the booster magnet are described. These include an antiproton beam storage ring and low energy antiproton beam acceleration. Emphasis, however, is placed on possible use for high energy antiproton beams. Initial calculations are presented which show that the magnet can be powered significantly above its design field, but more study is required on this option.

1552 (BNL—52082, pp 59-61) **Very low energy antiprotons.** Lee, Y.Y. 7 May 1987. NTIS, PC A05/MF A01. Order Number DE87012851/JAW. (CONF-8608192—; AGS/EP/S—87-1).

From Summer workshop on antiproton beams in the 2-10 GeV/c range; Upton, NY, USA (18 Aug 1986).

It has been proposed that the AGS Booster be used as a time stretcher/purifier for antiprotons of momentum .65 to 5.2 GeV/c. The lower limit corresponds to the linac output of 200 MeV kinetic energy. In this note the idea is extended to very low energy antiprotons at tens of KeV kinetic energy.

1553 **(DOE/ER/45183—3) Materials research and beam line operation utilizing NSLS [National Synchrotron Light Source]: Progress report.** Liedl, G.L. (Purdue Univ., Lafayette, IN (USA)). Oct 1987. Contract FG02-85ER45183. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000410/JAW.

MATRIX is a group of scientists who have common interests in utilizing x-ray synchrotron radiation for materials research. This group has developed a specialized beam line (X-18A) for x-ray scattering studies at the National Synchrotron Light Source (NSLS). The beam line was designed to optimize experimental conditions for diffuse scattering and surface/interface studies. An extension of diffuse scattering to provide better quantitative data has been shown as well as a unique application to the solution of the phase problem. In the x-ray surface scattering area the first reported experiment to illustrate the capabilities for studying monolayers on water was performed. Current beam line upgrade projects are also described. In addition to a change to a UHV system and improvements dictated by operational experience, two new systems are described, a unique small angle scattering chamber (SAXS) for dynamic studies of nucleation and growth and a surface scattering chamber. 5 figs.

1554 **(FNAL-TM—1469) Fast 4 to 8 GHz Debuncher betatron stochastic cooling for the Tevatron upgrade.** Mtingwa, S.K. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jul 1987. Contract AC02-76CH03000. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000695/JAW.

The present 2 to 4 Ghz Debuncher betatron stochastic cooling systems are designed to cool 7 x 10^7 antiprotons with initial transverse emittances of 20π mm-mrad down to 7π mm-mrad in 2 seconds. For the Tevatron upgrade, it would be advantageous to cool twice the number of antiprotons from 20π mm-mrad to 1πrd mm-mrad in half the time. We explore the possibility of achieving this goal with 4 to 8 Ghz stochastic cooling systems. Since the transverse beam size is initially more than twice the width of the cooling electrodes, we compare the effectiveness of one, two, and three plate pairs spaced strategically along the transverse beam direction. We also compare constant gap size electrodes with that for gap sizes which track the beam size as the emittance is reduced. We find that the three plate pair variable gap geometry performs the best, closely followed by the two plate pair variable gap geometry. Because of lower production costs we would suggest use of the latter. 8 refs., 7 figs., 37 tabs.

1555 **(FNAL-TM—1472) Simulation of the capture process in the Fermilab Booster.** Stahl, S.; Ankenbrandt, C. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1987. Contract AC02-76CH03000. 4p. (CONF-870302—251). NTIS, PC A02. Order Number DE88000692/JAW.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A progress report on efforts to understand and improve adiabatic capture in the Fermilab Booster by experiment and simulation is presented. In particular, a new RF voltage program for capture which ameliorates transverse space-charge effects is described and simulated. 7 refs., 4 figs.

1556 **(GANIL-A—86-06) High intensity and space charge problems at GANIL.** Baron, E.; Beck, R.; Bourgarel, M.P.; Bru, B.; Chabert, A.; Ricaud, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Oct 1986. 5p. (CONF-8610173—18). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752692/JAW.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

We routinely accelerate up to micro-amperes of ions at energies ranging from 25 to 95 MeV/A. Already at these levels, space charge (SC) problems drastically affect the bunching efficiency between the ECR external ion-source and our Co compact injector. Moreover in the "2.5" version of GANIL we expect currents above 50 eμA (Ar^+6 for instance) and SC effects will be of prime importance during acceleration in the injector and even in our first SSC. We present our computer codes and our first results.

1557 (GANIL-P—86-18) **LISE spectrometer at Ganil.** Saint-Laurent, M.G. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Aug 1986. 26p. (CONF-860815—15). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752697/JAW.

From 11. international conference on electromagnetic isotope separators and techniques related to their applications; Los Alamos, NM, USA (18 Aug 1986).

The doubly achromatic spectrometer LISE is available at the french national heavy ion accelerator GANIL. Experimental results, obtained in radioactive beam production and search for new exotic nuclei are briefly reported.

1558 (INIS-BR—725) **Determination of beam characteristic parameters for a linear accelerator.** Lima, D.A. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 8 May 1978. 66p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703477/JAW.

A mechanism to determine electron beam characteristic parameters of a linear accelerator was constructed. The mechanism consists in an electro-calorimeter and an accurate optical densitometer. The following parameters: mean power, mean current, mean energy/particle, pulse Width, pulse amplitude dispersion, and pulse frequency, operating the 2 MeV linear accelerator of CBPF (Brazilian Center pf Physics Researches). The optical isodensity curves of irradiated glass lamellae were obtained, providing information about focus degradation penetration direction in material and the reach of particle. The point to point dose distribution in the material from optical density curves were obtained, using a semi empirical and approached model. (M.C.K.).

1559 (KFKI—1987-17/M, pp 1-26) **Algorithms and codes for magnetostatic fields calculation of the electrophysical devices.** Ajryan, Eh.A.; Zhidkov, E.P.; Fedorov, A.V.; Khoromskij, B.N.; Shelaev, I.A.; Yudin, I.P.; Yuldashev, O.I. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Computing Techniques and Automation). Apr 1987. (In Russian). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700125/JAW.

In Collection of scientific papers in collaboration with Joint Institute for Nuclear Research, Dubna, USSR and Central Research Institute for Physics, Budapest, Hungary Pt. 5. Algorithms and programs for solution of some problems in physics.

Some algorithms for numerical calculations for one class of magnetic systems are described. These algorithms were implemented as FORTRAN codes and successfully used for magnetostatic field simulation in some JINR basic electrophysical devices. New results of calculations for the sections of the initial part of the LIA-30 and for the two magnets of the SCIN synchrotron (the quadrupole superconductive magnet of the insertion and the dipole magnet of the injection channel) are given. Pt. 4: KFKI–1983-21; 34 refs.; 10 figs.; 5 tables.

1560 (N—87-26173, pp vp) **Sputtering derived atomic oxygen source for studying fast atom reactions.** Ferrieri, R.A.; Yung, Y.C.; Wolf, A.P. Jun 1987. NTIS, PC A09/MF A01. (NASA-CR—181163; JPL—87-14; NAS—1.26:181163; CONF-8611131—).

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

A technique for the generation of fast atomic oxygen was developed. These atoms are created by ion beam sputtering from metal oxide surfaces. Mass resolved ion beams at energies up to 60 KeV are produced for this purpose using a 150 cm isotope separator. Studies have shown that particles sputtered with 40 KeV Ar(+) on Ta_2O_5 were dominantly neutral and exclusively atomic. The atomic oxygen also resided exclusively in its 3P ground state. The translational energy distribution for these atoms peaked at ca 7 eV (the metal-oxygen bond energy). Additional measurements on V_2O_5 yielded a bimodal distribution with the lower energy peak at ca 5 eV coinciding reasonably well with the metal-oxygen bond energy. The 7 eV source was used to investigate fast oxygen atom reactions with the 2-butene stereoisomers. Relative excitation functions for H-abstraction and pi-bond reaction were measured with trans-2-butene. The abstraction channel, although of minor relative importance at thermal energy, becomes comparable to the addition channel at 0.9 eV and dominates the high-energy regime. Structural effects on the specific channels were also found to be important at high energy.

1561 (N—87-26173, pp vp) **Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation.** Banks, B.; Rutledge, S.; Brdar, M.; Olen, C.; Stidham, C. (Cleveland State Univ., OH). Jun 1987. NTIS, PC A09/MF A01. (NASA-CR—181163; JPL—87-14; NAS—1.26:181163; CONF-8611131—).

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

A low energy neutral atomic oxygen beam system was designed and is currently being assembled at the Lewis Research Center. The system utilizes a 15 cm diameter Kaufman ion source to produce positive oxygen ions which are charge exchange neutralized to produce low energy (variable from 5 to 150 eV) oxygen atoms at a flux simulating real time low Earth orbital conditions. An electromagnet is used to direct only the singly charged oxygen ions from the ion source into the charge exchange cell. A retarding potential grid is used to slow down the oxygen ions to desired energies prior to their charge exchange. Cryogenically cooled diatomic oxygen gas in the charge exchange cell is then used to transfer charge to the oxygen ions to produce a neutral atomic oxygen beam. Remaining non-charge exchanged oxygen ions are then swept from the beam by electromagnetic or electrostatic deflection depending upon the desired experiment configuration. The resulting neutral oxygen beam of 5 to 10 cm in diameter impinges upon target materials within a sample holder fixture that can also provide for simultaneous heating and UV exposure during the atomic oxygen bombardment.

1562 (N—87-26173, pp vp) **Pulsed source of energetic atomic oxygen.** Caledonia, G.E.; Krech, R.H. Jun 1987. NTIS, PC A09/MF A01. (NASA-CR—181163; JPL—87-14; NAS—1.26:181163; CONF-8611131—).

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

A pulsed high flux source of nearly monoenergetic atomic oxygen was designed, built, and successfully demonstrated. Molecular oxygen at several atmospheres pressure is introduced into an evacuated supersonic expansion nozzle through a pulsed molecular beam valve. An 18 J pulsed CO_2 TEA laser is focused to intensities greater than 10(9) W/sq cm in the nozzle throat to generate a laser-induced breakdown. The resulting plasma is heated in excess of 20,000 K by a laser supported detonation wave, and then rapidly expands and cools. Nozzle geometry confines the expansion to provide rapid electron-ion recombination into atomic oxygen. Average O atom beam velocities from 5 to 13 km/s were measured at estimated fluxes to 10(18) atoms per pulse. Preliminary materials testing has produced the same surface oxygen enrichment in polyethylene samples as obtained on the STS-8 mission. Scanning electron microscope examinations of irradiated polymer surfaces reveal an erosion morphology similar to that obtained in low Earth orbit, with an estimated mass removal rate of approx. 10(-24) cu cm/atom. The characteristics of the O atom source and the results of some preliminary materials testing studies are reviewed.

1563 (N—87-26173, pp vp) **Production of pulsed atomic oxygen beams via laser vaporization methods.** Brinza, D.E.; Coulter, D.R.; Liang, R.H.; Gupta, A. Jun 1987. NTIS, PC A09/MF A01. (NASA-CR—181163; JPL—87-14; NAS—1.26:181163; CONF-8611131—).

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

Energetic pulsed atomic oxygen beams were generated by laser-driven evaporation of cryogenically frozen ozone/oxygen films and thin films of indium-tin oxide (ITO). Mass and energy characterization of beams from the ozone/oxygen films were carried out by mass spectrometry. The peak flux, found to occur at 10 eV, is estimated from this data to be 3 x 10(20) m(-2) s(-1). Analysis of the time-of-flight data indicates a number of processes contribute to the formation of the atomic oxygen beam. The absence of metastable states such as the 2p(3) 3s(1) (5S) level of atomic oxygen blown off from ITO films is supported by the failure to observe emission at 777.3 nm from the 2p(3) 3p(1) (5P/sub J/) levels. Reac-

tive scattering experiments with polymer film targets for atomic oxygen bombardment are planned using a universal crossed molecular beam apparatus.

1564 (N—87-26173, pp vp) **Production of low-energy neutral oxygen beams by grazing-incidence neutralization.** Albridge, R.G.; Haglund, R.F.; Tolk, N.H.; Daech, A.F. (Martin Marietta Aerospace, New Orleans, LA). Jun 1987. NTIS, PC A09/MF A01. (NASA-CR—181163; JPL—87-14; NAS—1.26:181163; CONF-8611131—).

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

The Vanderbilt University neutral oxygen facility produces beams of low-energy neutral oxygen atoms by means of grazing-incidence collisions between ion beams and metal surfaces. Residual ions are reflected by applied electric fields. This method can utilize initial ion beams of either O(+) or O_2(+) since a very large percentage of molecular oxygen ions are dissociated when they undergo grazing-incidence neutralization. The method of neutralization is applicable to low-energy beams and to all ions. Particular emphasis is on O and N_2 beams for simulation of the low Earth orbit space environment. Since the beam is a pure O-neutral beam and since measurements of the interaction of the beam with solid surfaces are made spectroscopically, absolute reaction rates can be determined. The technique permits the beams to be used in conjunction with electron and photon irradiation for studies of synergistic effects. Comparisons of optical spectra of Kapton excited by 2.5-keV O, O(+), and O_2(+) show significant differences. Optical spectra of Kapton excited by neutral oxygen beams of less than 1 keV have been recorded.

1565 (SAND—87-1732C) **Detuning the ion-hose instability.** O'Brien, K.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-871105—1; CONF-8709146—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000937/JAW.

From Meeting of the Division of Plasma Physics of the American Physical Society; San Diego, CA, USA (2 Nov 1987).

Ion line-density-modulation detuning of the coherent evolution of ion-hose instability in long-pulse-length electron beams propagating in the ion-focus regime is analyzed. For a specific weakly-detuned beam in a fast-rise channel we find the asymptotic growth is decreased in a fashion which is mathematically equivalent to the effect of an applied axial magnetic field. 10 refs.

1566 (SAND—87-2341C) **Endoatmospheric propagation experiments and accelerator development.** Hasti, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-8709146—8). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000928/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

The RADLAC program encompasses high power electron beam propagation experiments and accelerator development, both for advanced propagation experiments and to develop compact accelerator options for future charged particle beam weapons (CPBW). Propagation experiments include conditioning cell and lead pulse stability (LPS) experiments on RADLAC II, and channel-tracking experiments on IBEX. The RIIM accelerator was used for two-pulse accelerator experiments to explore two-pulse configurations for RADLAC II. The ion focused regime (IFR) transported, recirculating linear accelerator (RLA) experiment is aimed at future CPBW compact accelerator development. This paper briefly outlines recent work in these areas.

1567 (SAND—87-2348C) **Recirculating linear accelerator turning experiments.** Shope, S.L.; Bennett, L.F.; Hasti, D.E.; Kamin, G.W.; Tucker, W.K.; Lucero, S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-8709146—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000936/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

Ion focused transport is used to generate and transport a relativistic electron beam (REB) in a recirculating linac. An ionized channel is formed in low pressure argon with a low energy e-beam that is contained and guided by a 200 G magnetic field. A 1.5-MeV, 20-kA beam has been generated in the injector and accelerated to 2.5 MeV by the accelerating cavity. The REB has been transported and guided through a bend of 270°, with a total transport distance of 17 m. 9 refs., 6 figs.

1568 (SAND—87-2374C) **Experimental observation of ion hose instability.** Kamin, G.W.; O'Brien, K.J.; Lockner, T.R.; Wagner, J.S.; Shokair, I.R.; Kiekel, P.D.; Molina, I.; Armistead, D.J.; Lipinski, R.J.; Hogeland, S. (Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). 1987. Contract AC04-76DP00789. 7p. (CONF-8709146—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000924/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

A theoretically predicted instability in the ion-focus-regime (IFR) guiding of intense relativistic electron beams, known as the ion hose instability, has been definitively observed in this experiment. A 1.5-μs, 1.2-kA, 2.2-MeV electron beam has been successfully injected into and propagated down a 21-meter preionized channel. Off-axis beam oscillations have been found to grow and then saturate at large amplitude. Observed growth times, real frequencies, and saturated amplitudes are in agreement with theoretical scaling predictions and with numerical simulation of ion hose instability. 8 refs., 7 figs.

1569 (SLAC-PUB—4379) **An introduction to beamstrahlung and disruption.** Chen, P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Aug 1987. Contract AC03-76SF00515. 40p. (CONF-8610108—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000708/JAW.

From 2. joint US/CERN school on particle accelerators: frontiers of particle beams; South Padre Island, TX, USA (23 Oct 1986).

In this lecture we review the current understanding of the beam-beam interaction in e^+e^- linear colliders. Strictly speaking, the two effects, disruption and beamstrahlung, during beam-beam interaction are coupled. This is self-evident because without deflection there would be no radiation, and with radiation during bending the remaining trajectory of particles would not be the same. Fortunately, in a large range of beam parameters the average disruption angles are rather small, and the emission of hard photons are relatively rare. For these reasons the two effects can be isolated from each other to the first degree of accuracy, and our study of the issue can be greatly simplified. This happens also to be the development historically. We discuss the effects associated with disruption with negligible beamstrahlung. Here, an important parameter, the disruption parameter D, is introduced. We then discuss the maximum and rms disruption angles. The analytic scaling laws for D $>>$ 1 and D $<<$ 1 are then compared with simulation results. Next we investigate the enhancement of luminosity due to disruption. Together with the aspect ratio R identical to σ/sub x//σ/sub y/, the two parameters define a scaling law for luminosity enhancement, H/sub D1/, due to the mutual pinching of the e^+e^- bunches where the effective beam size σ/sub x/σ/sub y/ is reduced. Next we discuss beamstrahlung with negligible disruption. First we review the nature of beamstrahlung by describing the novel features of the problem. These specific features are then compared with the known radiation phenomena with emphasis on their similarities and differences. 36 refs.

1570 (SLAC-PUB—4391) **Quantum beamstrahlung from gaussian bunches.** Chen, P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Aug 1987. Contract AC03-76SF00515. 11p. (CONF-8706147—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000704/JAW.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

The method of Baier and Katkov is applied to calculate the correction terms to the Sokolov-Ternov radiation formula due to the variation of the magnetic field strength along the trajectory of a

radiating particle. We carry the calculation up to the second order in the power expansion of B tau/B, where tau is the formation time of radiation. The expression is then used to estimate the quantum beamstrahlung average energy loss from e^+e^- bunches with gaussian distribution in bunch currents. We show that the effect of the field variation is to reduce the average energy loss from previous calculations based on the Sokolov-Ternov formula or its equivalent. Due to the limitation of our method, only an upper bound of the reduction is obtained. 18 refs.

1571 **(SLAC-PUB—4411) Analysis of the orbit errors in the CERN accelerators using model simulation.** Lee, M.; Kleban, S.; Clearwater, S.; Scandale, W.; Pettersson, T.; Kugler, H.; Riche, A.; Chanel, M.; Martensson, E.; Lin, In-Ho. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Los Alamos National Lab., NM (USA); European Organization for Nuclear Research, Geneva (Switzerland); Sychrotron Radiation Research Center (Taiwan)). Sep 1987. Contract AC03-76SF00515. 5p. (CONF-8709151—1). NTIS, PC A02. Order Number DE88000700/JAW.

From Europhysics conference on control systems for experimental physics; Villars, Switzerland (28 Sep 1987).

This paper will describe the use of the PLUS program to find various types of machine and beam errors such as, quadrupole strength, dipole strength, beam position monitors (BPMs), energy profile, and beam launch. We refer to this procedure as the GOLD (Generic Orbit and Lattice Debugger) Method which is a general technique that can be applied to analysis of errors in storage rings and transport lines. One useful feature of the Method is that it analyzes segments of a machine at a time so that the application and efficiency is independent of the size of the overall machine. Because the techniques are the same for all the types of problems it solves, the user need learn only how to find one type of error in order to use the program.

1572 **(DESY-L-Trans—322) Matching the phase volume of a transported charge particle beam by a doublet of quadrupole lenses.** Yudin, I.P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). Apr 1987. Translation of Preprint JINR-P—9-86-601. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753291/JAW.

Translated from Russian.

The problem of matching the phase volume of a transported beam is commonly solved by nonlinear programming methods. Writing a system of matching equations that is transcendental, one can turn to the following stage: its solution by direct numerical methods. In this paper the system of matching equations will be reduced to one equation with one unknown by means of successive analytical transformations. This was achieved by the corresponding substitution of the variables. The last equation was solved on a computer. As a result, such characteristics as drift lengths, lengths and gradients of magnetic lenses are written analytically depending on the chosen vector of the parameters and the unknown quantity as indicated. The formulas obtained are realized as a FORTRAN program on a CDC-6500 computer. In the user's dialogue with the computer, this program allows to correct fast all values of free parameters and to choose the most economical version of the calculated matching structure. Geometrical and magnetic characteristics of the beam transport system under investigation are presented in the version conclusively chosen.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 1444, 1451, 1452, 1454, 1455, 1504, 1557, 1603, 2061, 2107, 2167, 2248, 2338

1573 **(BNL—40279) Heavy quark production at the SSC.** Dawson, S.; Haggerty, J.; Protopopescu, S.; Sheldon, P. (Brookhaven National Lab., Upton, NY (USA); Illinois Univ., Urbana (USA). Dept. of Physics). Sep 1987. Contract AC02-76CH00016. 23p. (CONF-870739—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001335/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

The production of a fourth generation of quarks at the SSC is studied. We emphasize the properties of the events which are relevant for detector design. Quarks up to masses of 1 TeV should be observable via their two lepton decay modes without placing stringent demands on the detector. 12 refs., 23 figs.

1574 **(FNAL-TM—1468) Resistor cooling in a vacuum.** Crittenden, R.; Krider, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). 31 Jul 1987. Contract AC02-76CH03000. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000696/JAW.

This note describes thermal measurements which were done on a resistor operating both in air at one atmosphere pressure and in a vacuum of a few milliTorr. The motivation for this measurement was our interest in operating a BGO crystal-photomultiplier tube-base assembly in a vacuum, as a synchrotron radiation detector to tag electrons in the MT beam. We wished to determine what fraction of the total resistor power was dissipated by convection in air, in order to know whether there would be excessive heating of the detector assembly in a vacuum. 3 figs.

1575 **(FNAL-TM—1470) SSC dipole vacuum vessel support placement analysis.** Nicol, T.H. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1987. Contract AC02-76CH03000. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000694/JAW.

Early (superconducting super collider) SSC dipole model magnets were supported at five points along their length by feet welded to the vacuum vessel. The cold mass was supported at the same five points. The number of supports was determined such that the maximum cold mass deflection between supports was limited to 0.010 inches as specified in the first version of the SSC Design Criteria. The spacing between supports was determined to minimize the sag of the cold mass, given five supports. This paper analyzes the deflection of the cold mass and vacuum vessel as a result of these supports. 4 refs. (LSP)

1576 **(FNAL-TM—1471) Limits on the transverse phase space density in the Fermilab Booster.** Ankenbrandt, C.; Holmes, S.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1987. Contract AC02-76CH03000. 4p. (CONF-870302—252). NTIS, PC A03. Order Number DE88000693/JAW.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Recent results on intensity and transverse density limitations in the Fermilab 8-GeV Booster are presented. The evidence suggests that the limits are set by incoherent space-charge effects at low energy. Data are interpreted in terms of the space-charge tune shift and possible means of improving performance further are discussed. 8 refs., 3 figs.

1577 **(FNAL-TM—1473) Transition jump system for the Fermilab Booster.** Merz, W.; Ankenbrandt, C.; Koepke, K. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1987. Contract AC02-76CH03000. 4p. (CONF-870302—250). NTIS, PC A02. Order Number DE88000691/JAW.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A transition-jump system recently installed in the Fermilab Booster is described. Early results of the commissioning are presented. 13 refs., 7 figs.

1578 **(FNAL-TM—1474) Finite element stress analysis of D0 test beam transporter mainframe assembly.** Wands, B. (Fermi National Accelerator Lab., Batavia, IL (USA)). 25 Sep 1987. Contract AC02-76CH03000. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000690/JAW.

The D0 test beam transporter mainframe assembly is a structural frame lying in a horizontal plane and designed to support and orient the D0 test liquid argon calorimeter properly in the test beam. Azimuthal adjustment is provided by a turntable with a mean radius of 64 inches, supported on a pressurized oil bearing. Angular

positioning is achieved by an hydraulic actuator attached to the turntable which places force against an arm on the calorimeter vessel, causing it to rotate. Vertical positioning is adjusted by jacks at four corners of the platform. Preliminary design calculations were based on simplifying and conservative assumptions which rendered the problem statically determinate. The purpose of this analysis is to provide more precise information on stress and deflection by including redundancies and structural detail. 2 figs., 1 tab.

1579 **(GANIL-A—86-03) Operation of the GANIL ECR source.** Baron, E.; Bex, L.; Bourgarel, M.P. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). May 1986. 7p. (CONF-8605131—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752689/JAW.

From 7. international ECR source workshop; Julich, F.R. Germany (22 May 1986).

The construction of the beam transport line for heavy ion axial injection into the second GANIL injector cyclotron has been completed in July 1985. This line has been tested from July to December 1985, with the ECR source, which was operating since December 1984. Since this date the ECR source is operating regularly at GANIL and produces sufficient intensities of ion beam from gases.

1580 **(GANIL-A—86-11) Injection and extraction systems and beam tuning procedures of coupled cyclotrons.** Beck, R.; Bru, B.; Duval, M.; Ferme, J.; Ricaud, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752694/JAW.

The following description of injection and ejection systems, and the recommendations given for the tuning of coupled cyclotrons have a limited scope. Each cyclotron facility has its own peculiarities the energy range, the maximum intensity, the various types of accelerated ions, the beam emittance area. The information given in this paper will be mainly based on the experience gathered at GANIL. Technical data will be given as far as they are needed for the comprehension of the problems by the users of facilities with similar design. This paper is divided in three parts: 1. General remarks 2. Injection and ejection, 3. Beam lines.

1581 **(LA-UR—87-2980) GOLD: Integration of model-based control systems with artificial intelligence and workstations.** Lee, M.; Clearwater, S. (Los Alamos National Lab., NM (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Aug 1987. Contract W-7405-ENG-36. 10p. (CONF-8708145—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000506/JAW.

From Workshop on model based accelerator controls; Upton, NY, USA (16 Aug 1987).

Our experience with model based accelerator control started at SPEAR. Since that time nearly all accelerator beam lines have been controlled using model-based application programs, for example, PEP and SLC at SLAC. In order to take advantage of state-of-the-art hardware and software technology, the design and implementation of the accelerator control programs have undergone radical change with time. Consequently, SPEAR, PEP, and SLC all use different control programs. Since many of these application programs are imbedded deep into the control system, they had to be rewritten each time. Each time this rewriting has occurred a great deal of time and effort has been spent on training physicists and programmers to do the job. Now, we have developed these application programs for a fourth time. This time, however, the programs we are developing are generic so that we will not have to do it again. We have developed an integrated system called GOLD (Generic Orbit and Lattice Debugger) for debugging and correcting trajectory errors in accelerator lattices. The system consists of a lattice modeling program (COMFORT), a beam simulator (PLUS), a graphical workstation environment (micro-VAX) and an expert system (ABLE). This paper will describe some of the features and applications of our integrated system with emphasis on the automation offered by expert systems. 5 refs.

1582 **(LA-UR—87-3037) Limitations on the use of the pulsed-wire field-measuring technique.** Warren, R.W. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 17p. (CONF-8709110—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000530/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

As wigglers become longer and the wavelength of the light they produce becomes shorter, the requirements for magnetic field uniformity and precision of wiggler construction become more severe. Techniques used to measure magnetic fields and to estimate the performance of wigglers are now being pushed to their limits in precision and are generally awkward and time consuming in practice. A new field-error measurement technique has been developed that has the usual advantages of a null technique, demonstrates high sensitivity to field errors, and is rapid and simple to employ. With this technique, it appears practical to use computer control to both measure and correct field errors. In a particularly attractive application, these measuring and correcting steps could be carried out on a daily basis for an operational wiggler, which is mounted under vacuum in its optical cavity. In this way, changes in the fields caused by aging or by thermal or radiation-induced deterioration effects could be rapidly identified and corrections could be instituted without significant interruption to normal operations. The principles and limitations of ths technique will be described and examples given of various implementations that have been examined experimentally. 10 refs., 2 figs., 2 tabs.

1583 **(LA-UR—87-3043) Radiation-induced changes in magnetic properties of Nd-Fe-B permanent magnets.** Brown, R.D.; Cost, J.R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 15p. (CONF-871126—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000528/JAW.

From 32. conference on magnetism and magnetic materials; Chicago, IL, USA (9 Nov 1987).

The high remanence and intrinsic coercivity of Nd-Fe-B magnets make them desirable for use in the accelerators. Use in the radiation environment of an accelerator requires that the sensitivity of these magnets to radiation be determined and the mechanisms responsible be understood. We present results comparing the relative radiation sensitivity of a number of commercially available Nd-Fe-B magnets. Small samples of these magnets were irradiated at the Omega West Reactor in a neutron flux of 2×10^{13} n/cm^{2}s at a temperature of 350°K (77°C). At various time intervals during the irradiation, samples were removed from the reactor and the open-circuit remanence measured. We also measured the second quadrant demagnetization curve of samples before and after neutron irradiation to monitor changes in remanence and intrinsic coercivity. Our results show that the sensitivity to radiation varies widely among magnets from different vendors. In general, these samples showed a decrease in the remanence and an increase in the intrinsic coercivity. We present results showing that the rate of remanence decay decreases monotonically with increasing length-to-diameter (L/D) ratio for samples of the same material. Thus, it is important to compare decay rates corrected to some constant L/D ratio. 7 refs., 3 figs., 2 tabs.

1584 **(LA-UR—87-3145) The status of the LAMPF control system upgrade.** Carr, G.P.; Schaller, S.C.; Bjorklund, E.A.; Burns, M.J.; Harrison, J.F.; Rose, P.A.; Schultz, D.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-8709151—3). NTIS, PC A02. Order Number DE88000497/JAW.

From Europhysics conference on control systems for experimental physics; Villars, Switzerland (28 Sep 1987).

The upgraded Los Alamos Meson Physics Facility (LAMPF) control system is now operational. The SEL-840 computer has been removed, and all application programs are now running on VAXes. We are continuing to upgrade the control system network. We are using MicroVMS systems for distributed local control and have introduced VAXELN systems for dedicated real-time situations. Communications with both systems is based on a standardized remote procedure call interface. We have also begun to integrate the Proton Storage Ring controls with the LAMPF control system, to experiment with VAX/GPX-based workstation

operator interfaces, and to investigate possible applications of artificial intelligence technology. 13 refs.

1585 **(LA-UR—87-3239) Toward automated beam optics control.** Silbar, R.R.; Schultz, D.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-8709151—2). NTIS, PC A02. Order Number DE88000485/JAW.

From Europhysics conference on control systems for experimental physics; Villars, Switzerland (28 Sep 1987).

We have begun a program aiming toward automatic control of charged-particle beam optics using artificial intelligence programming techniques. In developing our prototype, we are working with LISP machines and the KEE expert system shell. Our first goal was to develop a "mouseable" representation of a typical beam line. This responds actively to changes entered from the mouse or keyboard, giving an updated display of the beam line itself, its optical properties, and the instrumentation and control devices as seen by the operater. We have incorporated TRANSPORT, written in Fortran but running as a callable procedure in the LISP environment, for simulation of the beam-line optics. This paper describes the experience gained in meeting our first goal and discusses plans to extend the work so that it is usable, in realtime, on an operating beam line. 11 refs.

1586 **(LBL—23777) A water-cooled mirror system for synchrotron radiation.** DiGennaro, R.; Gee, B.; Guigli, J.; Hogrefe, H.; Howells, M.; Rarback, H. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 27p. (CONF-870610—12). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000206/JAW.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

This paper describes the design and performance of a directly-cooled soft x-ray mirror system which has been developed at Lawrence Berkeley Laboratory for synchrotron radiation beam lines in which mirror thermal distortion must be minimized for acceptable optical performance. Two similar mirror systems are being built: the first mirror has been installed and operated at the National Synchrotron Light Source on the X-17T mini-undulator beam line and will be moved to the permanent X-1 beam line when a new, more powerful undulator is installed there. The second system is being built for installation at the Stanford Synchrotron Radiation Laboratory on Beam Line VI, where the total absorbed power on the mirror may be as high as 2400 W with peak absorbed power density of 520 W/cm^2. Direct cooling by convection is achieved using internal water channels in a brazed, dispersion-strengthened copper and OFHC copper substrate with a polished electroless-nickel surface. A simple kinematic linkage and flexural pivot mounting provide for mirror positioning about two rotational axes that coincide with the optical surface. Surface figure metrology, optical configurations, and tolerancing are also discussed. 11 refs., 8 figs.

1587 **(NAC—86-07) Proposal for a helium cooling system for beam foil windows.** Steyn, G.F.; Nortier, F.M. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Accelerator Centre). 1986. 26p. CSIR, National Accelerator Centre, P.O. Box 72, Faure, South Africa.

Thin metal foil windows can be used to isolate the target from the beam line in such a way that very little degradation of the beam takes place. The heat dissipated in these windows should be removed sufficiently to keep their operating temperatures well below melting point. Water cooling of the window edges can be provided but is usually insufficient. Additional cooling can be provided by blowing a suitable cooling gas (usually helium) across the window surface and this technique can best be implemented by using double foil window systems and by blowing the cooling gas through the space between the two foils. A summary of relevant publications is given with the emphasis on windows in different target designs, window strength and helium cooling systems. An experiment is also performed to determine the cooling power densities of helium at room temperature and an average pressure of 1 Atm. for different surface temperatures. The design of a possible helium cooling system for the Radioisotope Production Division is shown.

1588 **(SAND—87-1886C) Trajectory code studies of the Delphi accelerator.** Poukey, J.W.; Stinnett, R.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-8709146—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013810/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

An electron trajectory code is used to study the design of the injector and field coil system for a prototype of Delphi. For a 1 kA beam, fields of about 1 kG can keep the angular divergence to less than 1°.

1589 **(SAND—87-2343C) IBEX channel formation.** Jones, E.E.; Frost, C.A.; Freeman, J.R.; Jojola, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-8709146—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000925/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

Exploding wire experiments have been conducted to form a low-density channel for endoatmospheric channel-tracking experiments to be performed on the IBEX accelerator. Stainless steel and tungsten wires as small as six microns radius have been exploded using a 50 kJ, 200 kV fast capacitor bank designed and constructed for the purpose. Density channels have been produced. Preliminary results will be compared with a simple circuit model and hydrocode analysis. Efforts to diagnose the low-density channel are beginning. 5 refs.

1590 **(SAND—87-2368C) Optical diagnostics for relativistic electron beams.** Crist, C.E.; Leifeste, G.T.; Wagner, J.S.; Stygar, W.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-8709146—9). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000927/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

Many optical diagnostics are available to the experimentalist of relativistic electron beams. These diagnostics provide very attractive benefits that include high resolution time-resolved measurements with a fast frequency response and broad bandwidth. Many also offer noninvasive attributes and can cope with severe radiation environments. Optical diagnostics provide the flexibility of use at virtually any location along the path of the relativistic electron beam. Temporal and or spatial calibrations can be performed and can provide a cross calibration for other diagnostics. Although each of these optical sensors provides a unique data path for the characterization of a particle beam, analyzed results yield good agreement between various beam parameters. A single computer system can greatly facilitate the use of optical diagnostics by increasing the ease and speed of data reduction. 2 refs., 6 figs.

1591 **(SLAC—319) Production of high intensity electron bunches for the SLAC Linear Collider.** James, M.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Aug 1987. Contract AC03-76SF00515. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001331/JAW.

This thesis describes the design and performance of a high intensity electron injecfor for the SLAC Linear Collider. Motivation for the collider and the specifications for the injector are discussed. An analytic theory of the bunching and capture of electrons by rf fields is discussed in the limit of low space charge and small signal. The design and performance of SLAC's main injector are described to illustrate a successful application of this theory. The bunching and capture of electrons by rf fields are then discussed in the limit of high space charge and large signal, and a description of the design of the collider injector follows. In the limit of high space charge forces and large rf signals, the beam dynamics are considerably more complex and numerical simulations are required to predict particle motion. A computer code which models the longitudinal dynamics of electrons in the presence of space charge and rf fields is described. The results of the simulations, the resulting collider injector design and the various components which make up the collider injector are described. These include the gun, subhar-

monic bunchers, traveling-wave buncher and velocity-of-light accelerator section. Finally, the performance of the injector is described including the beam intensity, bunch length, transverse emittance and energy spectrum. While the final operating conditions differ somewaht from the design, the performance of the collider injector is in good agreement with the numerical simulations and meets all of the collider specifications. 28 refs.

1582 **(SLAC-PUB—4396) GOLD: Integration of model-based control systems with artificial intelligence and workstations.** Lee, M.; Clearwater, S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Los Alamos National Lab., NM (USA)). Aug 1987. Contract AC03-76SF00515. 5p. (CONF-8708145—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000706/JAW.

From Workshop on model based accelerator controls; Upton, NY, USA (16 Aug 1987).

Our experience with model-based accelerator control started at SPEAR. Since that time nearly all accelerator beamlines have been controlled using model-based application programs, for example, PEP and SLC at SLAC. In order to take advantage of state-of-the-art hardware and software technology, the design and implementation of the accelerator control programs have undergone radical changes with time. Consequently, SPEAR, PEP and SLC all use different control programs. Since many of these application programs are embedded deep into the control system, they had to be rewritten each time. Each time this rewriting has occurred a great deal of time and effort has been spent on training physicists and programmers to do the job. Now, we have developed an integrated system called GOLD (Genetic Orbit and Lattice Debugger) for debugging and correcting trajectory errors in accelerator lattices. The system consists of a lattice modeling program (COMFORT), a beam simulator (PLUS), a graphical workstation environment (micro-VAX) and an expert system (ABLE). This paper will describe some of the features and applications of our integrated system with emphasis on the automation offered by expert systems. 5 refs.

4304 Storage Rings

1583 **(CEA-CONF—8830) Modification of the electron bunch shape induced by the Orsay storage ring FEL.** Couprie, M.E.; Elleaume, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Sep 1986. 19p. (CONF-8609131—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752749/JAW.

From 8. international free electron laser conference; Glasgow, UK (1 Sep 1986).

Experiments have been performed on ACO to study the change of shape of the electron bunch induced by the free electron laser. The method of measurement used here exploits the Fourier transform properties by analysing the frequency spectrum of the signal from a pick-up electrode. When the laser is on, the electron bunch is no longer gaussian, and the anomalous electron bunch oscillations are stabilized.

1584 **(GSI—86-26-Prepr.) Atomic physics at the ESR storage ring.** Beyer, H.F. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Aug 1986. 14p. (CONF-8608108—6-Prepr.). NTIS, PC E07; NTIS as TIB/B87-11439.

From International seminar on dynamic processes of highly charged ions; Susono, Shizuoka-ken, Japan (21 Aug 1986).

The study of the physics of few-electron very heavy ions such as U/sup 91+/ looks very promising as an approach to interesting and fundamental points in atomic physics. The GSI Heavy-Ion-Synchrotron (SIS) and the Experimental-Storage-Ring (ESR) facilities to be built will offer unique possibilities for such an experimental program to be carried out. We give an overview of the SIS and ESR projects, a more general introduction to phase-space cooling concepts being applied at storage rings and an outline of the atomic-physics program being presently in discussion.

1595 **(KEK—86-12) Effects of insertion devices on betatron functions and their correction in the low emittance mode of the photon factory storage ring.** Katoh, Masahiro; Honjo, Ichiro; Kamiya, Yukihide. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Mar 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750285/JAW.

A method to correct large tune shifts and distortions of betatron functions caused by insertion devices is presented. In this method, the k-values of several quadrupole magnets neighboring to the insertion devices are changed so as to minimize the distortions. The computer calculations show that the distortions can be reduced to acceptably small values.

1596 **(KEK—86-14) TRISTAN, electron-positron colliding beam project.** (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Mar 1987. 214p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750304/JAW.

In this report e/sup +/e/sup -/ colliding beam program which is now referred to as TRISTAN Project will be described. A brief chronology and outline of TRISTAN Project is given in Chapter 1. Chapter 2 of this article gives a discussion of physics objectives at TRISTAN. Chapter 3 treats the overall description of the accelerators. Chapter 4 describes design of each of the accelerator systems. In Chapter 5, detector facilities are discussed in some detail. A description of accelerator tunnels, experimental areas, and utilities are given in Chapter 6. In the Appendix, the publications on the TRISTAN Project are listed.

1597 **Macroscopic quantum-mechanical contributions to radiative polarization in electron storage rings.** Hand, L.N.; Skuja, A. (Deutsches Elektronen SynchrotronDESY, 2000 Hamburg 52, Federal Republic of Germany). *Physical Review Letters;* **59**: No. 17, 1910-1913(26 Oct 1987).

We present a complete first-order quantum electrodynamics calculation of the spin polarization in a relativistic electron storage ring. The result differs from previous semiclassical calculations of other authors in several respects. Under ideal conditions a maximum polarization of 99.2% may be obtained.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 696, 785, 787, 847, 850, 950, 1574, 1590, 1654, 1870, 1875, 2057, 2084, 2149, 2166, 2167, 2192, 2287, 2370, 2396, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2596

1598 **(AAEC/E—647) Coincidence counting corrections for dead time losses and accidental coincidences.** Wyllie, H.A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700089/JAW.

An equation is derived for the calculation of the radioactivity of a source from the results of coincidence counting taking into account the dead-time losses and accidental coincidences. The derivation is an extension of the method of J. Bryant [Int. J. Appl. Radiat. Isot., 14:143, 1963]. The improvement on Bryant's formula has been verified by experiment.

1599 **(ANU-P—971) Time-of-flight system for a heavy ion magnetic spectrometer.** Catford, W.N.; Fifield, L.K.; Hotchkis, M.A.C.; Ophel, T.R.; Orr, N.A.; Weisser, D.C.; Woods, C.L. (Australian National Univ., Canberra. Dept. of Nuclear Physics). May 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700097/JAW.

A system to measure the time of flight for heavy ions around an Enge split-pole magnetic spectrometer has been developed. The system consists of a parallel plate avalanche counter at the focal plane and either a microchannel plate detector or a silicon recoil detector in the target chamber. In-beam tests under experimental conditions have demonstrated a typical resolution of 1.0 to 1.5 ns,

compared to a total flight time of — 100 ns. Resolution figures approaching these have been recovered, when using the 4.5 deg angular acceptance of the spectrometer, by applying calculated corrections to the raw data according to the angle and focal plane position. A description of the detectors is followed by the results of the in-beam tests. An example of an application to the study of a heavy ion reaction is also described.

1600 **(CEGB-TPRD/B—0851/R86) Progress towards the development of a personal neutron dosimetry system based on the chemical etch of CR39.** Harvey, J.R.; Weeks, A.R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1986. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87752937/JAW.

A brief historical review of systems used for monitoring individual neutron dose underlines the significance of the discovery that the plastic CR39 can be used to detect protons, and hence form the basis of a great improvement in neutron dosimetry. Proton tracks are revealed by etching the CR39 plastic in a hot concentrated caustic solution. First studies at BNL into the fundamental etch characteristics of commercially available CR39 showed that dosimetry grade material would be required with a low density of spurious etch pits and reproducible etch characteristics. This is now commercially available. There was also a requirement for a simple system which would give a rapid estimate of the number of etch pits with diameters less than 6 μm over areas of order one square centimetre. Many possible systems were studied. The one shown to be most effective is based on side illumination of the CR39 sample which is then viewed by a videcon tube through a low-power microscope. The etch pit images which are effectively magnified by the videcon tube are counted by an inexpensive automatic image analysis system in less than one second. The thermal neutron sensitive CR39 is ideal for use as the detecting element in an albedo dosimetry system. This implies that a single dosemeter, of size comparable with the present film badge can be used to detect thermal, intermediate, and fast neutrons, the measurement of which currently requires two separate dosemeters.

1601 **(CERN-EP—86-214) Fibre calorimeters: Dense, fast, radiation resistant.** Sonderegger, P. (European Organization for Nuclear Research, Geneva (Switzerland)). 16 Dec 1986. 12p. (CONF-8605164—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900058/JAW.

From 2. topical seminar on perspectives for experimental apparatus at future high energy machines; San Miniato, Italy (5 May 1986).

Dense electromagnetic calorimeters made of scintillating fibers embedded in grooved Pb sheets or similar configuration are described. The Omega Inner Calorimeter is entering its third year of successful operation. Some future prospects are discussed. 16 refs., 2 figs., 1 tab.

1602 **(CERN-EP—87-14) Operation of multidrift tubes with dimethyl ether.** Bouclier, R.; Charpak, G.; Garabatos, J.; Guerard, B.; Santiard, J.C.; Solomey, N.; Sauli, F. (European Organization for Nuclear Research, Geneva (Switzerland)). 20 Jan 1987. 13p. (CONF-8609283—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900029/JAW.

From Workshop on vertex detectors: state of the art and perspectives; Erice, Italy (21 Sep 1986).

We have built several 80 cm long multiwire drift tubes, each with 70 independent drift cells constituted by individual anodes centered in a hexagonal cell, 1.45 mm in radius, defined by six cathode wires. A thin hexagonal carbon-fiber envelope, 30 mm in diameter, supports the wire tension and provides gas tightness. Charged tracks are measured, recording drift-times on all anodes, on an average ten times on each module; the longitudinal coordinate is measured from current division at the two ends of each wire. This paper presents the results of measurements realized with dimethyl ether as gas filling in the detection of minimum-ionizing particles.

1603 **(CERN-EP—87-88) Detection of Jets with calorimeters at future accelerators.** Akesson, T.; Albrow, M.; Burrows, P.N.; Cox, T.; de Brion, J.P.; Fabjan, C.; Holder, M.; Ingelman, G.; Jarlskog, G.; Meier, K. (European Organization for Nuclear Research, Geneva (Switzerland)). 12 May 1987. 32p. (CONF-870180—4). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900051/JAW.

From Workshop on physics at future accelerators; La Thuile, Italy (7 Jan 1987).

The results presented here are from the Jet-Calorimeter Working Group. A small-radium silicon calorimeter is suggested for a high-luminosity pp machine. Calorimetric limitations for measuring the kinematic variables in ep collisions are examined. The effects of beamstrahlung at a 2 TeV e^+e^- machine are estimated, and a detector for this machine is outlined.

1604 **(CERN-EP—87-109) Data acquisition and analysis of calorimetric signals.** Niinikoski, T.O.; Rijllart, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 23 Jun 1987. 9p. (CONF-8703176—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900048/JAW.

From Workshop on low temperature detectors for low energy neutrinos and dark matter; Munich, F.R. Germany (12 Mar 1987).

Calorimetric signals have been obtained by irradiating implanted Si and melt-doped Ge detectors of about one cubic millimetre size with an alpha source. A room temperature preamplifier and a CAMAC-based data-acquisition system have been used to resolve the time structure of the signals and to filter them for spectrum analysis. The thermal response is analysed in terms of a model with two heat reservoirs. 3 refs., 7 figs.

1605 **(CONF-871007—8) A compact permanent magnet proton spectrometer.** Obst, A.W.; King, N.S.P.; Hancock, A.D.; Hilko, R.A.; Boyer, K.G.; Enge, H.A.; Holsinger, R.F.; Lown, R.R. (Los Alamos National Lab., NM (USA); EG and G Energy Measurements, Inc., Los Alamos, NM (USA); Air Force Academy, CO (USA). Dept. of Physics; Massachusetts Inst. of Tech., Cambridge (USA); Field Effects, Inc., Acton, MA (USA)). 1987. Contract AC08-83NV10282. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000996/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A compact spectrometer using samarium-cobalt permanent magnet material has been developed for observing 8 to 22 MeV protons. The spectrometer consists of a single quadrupole element followed by a dipole element. The device has an acceptance of approximately 3 msr and an instrumental resolution (FWHM) of approximately 80 keV at 10 MeV and 150 keV at 18 Mev. 10 refs., 12 figs.

1606 **(CONF-871007—11) Error analysis of a recoil proton telescope containing silicon detectors for measurements of intense neutron sources.** Hilko, R.A.; Stelts, M.L.; Glasgow, D.W. (EG and G Energy Measurements, Inc., Los Alamos, NM (USA); Los Alamos National Lab., NM (USA)). 1987. Contract AC08-83NV10282. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000995/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

This error analysis was done to support the neutron diagnostic group for the Weapons Test Program. This presentation deals primarily with the uncertainty in the measurement of neutron rates using a recoil proton telescope with silicon detectors. 3 refs., 14 figs., 13 tabs.

1607 **(CRN-PN—85-23) Readout electronics of Spes III migration chambers. Preamplification and signal transport electronics of migration chambers.** Aslanides, E.; Bergdolt, A.M.; Bergdolt, G.; Ernwein, R.; Fassnacht, P.; Guterl, P.; Hibou, F.; Westermann, G. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1985. 14p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752702/JAW.

Preamplification and shaping of signals coming from measurement wires are realized by preamplification-discrimination circuits. Signals are then carried to measurement room. They are introduced in time coding system, through level restitution circuits in line receptor modules.

1608 **(CRN-PN—85-24) Readout electronics of Spes III migration chambers. Nevis migration time coding system.** Aslanides, E.; Bergdolt, A.M.; Bergdolt, G.; Ernwein, R.; Fassnacht, P.; Guterl, P.; Hibou, F. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1985. 22p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752703/JAW.

Time coder is presented: it digitizes the time intervals between the successive signals from 8 entrance ways and triggering entrance. The Encoder module is aimed at reading and processing the data registered by the time coders. The associated modules are presented (oscillator-clock distributor-test signal distributor).

1609 **(CRN-PN—85-25) Readout electronics of Spes III migration chambers. Control and Camac interface modules for Nevis system.** Ernwein, R.; Guterl, P.; Ring, C. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1985. 20p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752704/JAW.

To the elements of the time coding system have been joint some modules allowing a quick operation of the different possibilities of the system, the data transmission towards the Camac standard and the test of the different elements of the system. Two modules have been developed: the control module, the Camac-Nevis interface module.

1610 **(CRN-PN—85-26) Readout electronics of Spes III migration chambers. Modules for test of Nevis system.** Ernwein, R.; Guterl, P. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1985. 12p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752705/JAW.

The Nevis system is completely digital. Following tests are however necessary: clock symmetry and calibration of time coders.

1611 **(DOE/ER/40200—116) Radiative corrections to the solar neutrino counting rate in the gallium detector.** Dicus, D.A.; Wilson, S.L. (Texas Univ., Austin (USA). Center for Particle Theory). Sep 1987. Contract FG05-85ER40200. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001672/JAW.

We calculate radiative corrections to the flux from various solar neutrino processes and to the counting rate of neutrinos in the gallium solar detector. 9 refs., 1 tab.

1612 **(DOE/ID/12584—3) Construction and characterization of the TL/TH thorium calibration pads.** Steele, W.D. (UNC Geotech, Grand Junction, CO (USA)). Sep 1987. Contract AC07-86ID12584. 62p. (UNC/GJ—32-TMC). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87014712/JAW.

The Technical Measurements Center (TMC) was established and was tasked with developing and/or recommending measurement methods for use in support of remedial action programs. Since one aspect of this technical support is the provision of calibration facilities for standardization of field measurements, four sets of thorium-232 enriched pads (two pads per set) were constructed for use by remedial action contractors in calibrating portable field instruments that are used to make direct, in-situ measurements of radium-226, thorium-232, and potassium-40. This report presents the design, construction, and characterization data of the eight calibration pads. 17 refs., 8 figs., 15 tabs.

1613 **(FNAL/C—87/127) Some new ideas in liquid detectors.** Anderson, D.F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1987. Contract AC02-76CH03000. 15p. (CONF-8709153—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000732/JAW.

From Conference on position-sensitive detectors; London, UK (7 Sep 1987).

Three new techniques for the detection and imaging of the energy deposited in liquid detectors are discussed. These are electrostatic imaging in liquid argon doped with methane, photon mediated charge amplification in liquid xenon containing photosensitive dopants, and electron extraction from liquid argon and 2,2,4,4-TMP with charge amplifiction in the gas phase. 29 refs., 7 figs.

1614 **(FNAL/C—87/137) Detector dependent contributions to jet resolution.** Freeman, J.; Newman-Holmes, C. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1987. Contract AC02-76CH03000. 11p. (CONF-870739—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000733/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

We present results of calculations undertaken to study detector dependent effects that contribute to the energy resolution of jets. To accomplish this study, we have developed a fast, easily varied simulation of a generic 4π calorimeter. Physics processes used for benchmarks of performance were the transverse energy resolution of 1 TeV jets and the mass resolution of $W \rightarrow 2$ jets, for W's with 500 GeV transverse momentum. 3 refs.

1615 **(GSI—87-20-Prepr.) Photodiode readout and pulse shape analysis of CsI(Tl) scintillator signals.** Kreutz, P.; Kuehmichel, A.; Pinkenburg, C.; Pochodzalla, J.; Guo, Z.Y.; Lynen, U.; Sann, H.; Trautmann, W.; Trockel, R. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik). Apr 1987. 13p. NTIS, PC E07; NTIS as TIB/B87-11071.

The light output performance of CsI(Tl) scintillators coupled directly or via wavelength shifters to a photodiode is investigated. Using a photodiode readout system, the zero-crossing technique of pulse shape anlaysis has been employed to identify gammas, neutrons and charged particles (p,d,t,α) with a low energy threshold.

1616 **(HD-PY—87/2) Parallel data analysis in a multichannel Flash-ADC-system.** Eckerlin, G.; Elsen, E.; Schmitt, H. von der; Wagner, A.; Walter, P.v.; Zimmer, M. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.). 1987. 10p. Also published in IEEE Trans. Nucl. Sci. (Feb 1987) Vol. 34(1) p. 182-186.

Parallel analysis of drift chamber signals with M68000 processors has proven to be an efficient way to deal with the tremendous data flow generated by high speed (100 MHz) Flash-ADCs in real time. We report on the experience gained with a network of 34 processors, placed in 3 VME crates, to read out the 3072 Flash-ADC channels of the JADE Jet-Chamber at PETRA. The properties of such a system are compared to more conventional readout schemes for drift chambers.

1617 **(IEN-DIFIS—01/87) RUBBER computer code for interpolating response functions of NE-213 detectors from functions calculated by Monte Carlo simulation.** Antunes, L.J. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1987. 15p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703682/JAW.

The elaboration of a program for interpolating response functions of NE-213 detectors from simulated spectra using Monte Carlo method is presented. (M.C.K.).

1618 **(INIS-BR—715) Experimental determination of alpha particle threshold detection in cellulose nitrate.** Knoefell, T.M.J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1978. 53p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703467/JAW.

LR 115, type II, Kodak-Pathe cellulose nitrate pellicles were irradiated perpendicularly with monoenergetic alpha bemas in the energy range 2,5-5,5 Mev. The alpha particle beams were produced by an intense Am/sup 241/ source using Argon as energy attenuating. After irradiations, samples were etched with NaOH solutions without agitation at 60/sup 0/C, by different time periods varying from 15 minutes to 3,5 hours. Measurements of density and track diameter were done using optical microscopy. The sample compositions were done by CHN method of combustion gas analysis showing good agreement with the composition of cellulose trinitrate. From detection threshold and from obtained results, the development of latent tracks only occur for alpha particles with stopping power superior to 0,87/sup +-/0,06 MeV.cm/sup -2/.mg/sup -1/, was verified. (M.C.K.).

1619 **(INIS-BR—719) Fabrication of prototypes of Ge(li) semiconductor detector.** Santos, W.M.S.; Marti, G.V.; Rizzo, P.; Barros, S. de. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1987. 3p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703471/JAW.

The fabrication process of Ge(Li) semiconductor detector prototypes, from specific chemical treatments of doped monocrystal with receptor impurities (p/sup +/ semicondutor) is presented. The detector characteristics, such as resulotion and operation tension are shown. (M.C.K.).

1620 **(INIS-BR—724) Some characteristics of the CR-39 solid state nuclear - Track Detector for register of protons and low energy alpha particles.** Fonseca, E.S. da. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 63p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703476/JAW.

Experimental results related to registration properties of the CR-39 Solid State Nuclear Track Detector for charged particles are presented and discussed. The existence of an inverse proportion between the induction time and the temperature as well as normal concentration of solutions, is showed by the study of CR-39 chemical etching characteristics in NaOH and KOH solutions, comprising varied concentration and temperature. The bulk-etch rate and activation energy of the process were obtained. The critical energy and critical energy-loss rate of CR-39 track-detectors for registration of protons were experimentally determined. Samples were exposed to 24 Mev proton beams in the IEN/CNEN Cyclotron (CV-28), using scattering chamber with a tantalum thin target and aluminium absorbers in contact with the samples, in order to provide the required fluctuation in the scattered beam energy. From the mean track-diameter plotted against incident proton energy the critical energy was obtained. From the calculated energy-loss rate vs. energy curve, the critical energy loss rate were evaluated. The CR-39 response for low energy alpha particles (E < = 6MeV) was investigated. The results indicate good energy resolution for long chemical etching times (> = 7h) under the conditions of 6.25 N NaOH at 70/sup 0/C. It is shown that successive chemical etchings do not produce the same track geometry as obtained by means of a continous revelation with the same total etching time.

1621 **(INIS-mf—10721) Density dependence of the fine-differential disturbed gamma-gamma-spatial correlation in gaseous /sup 111/InI-sources.** Schuetter, K. (Goettingen Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fachbereiche). 5 Jul 1985. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753303/JAW.

An instrument for measuring a time-differential disturbed angular correlation was developed. Using this instrument the disturbance of the spatial correlation of the γ-quanta of the 171-245 keV γ-γ-cascade in /sup 111/Cd was examined in dependence of the density of the gaseous /sup 111/InI-systems and the time difference between the emission of the both γ-quanta. (BBOE).

1622 (INIS-mf—11001, pp 132-138) **Modern techniques of monitoring in neutronic/gamma radiation fields.** Doerschel, B; Pretzsch, G.; Streubel, G. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

New methods of neutron and gamma-radiation detection based on mechanical, thermal or electric effects in solid detectors are reviewed. Physics of the mentioned effects and their applicability for radiation measuring are discussed. Detailed descriptions of the neutron thin-film-capacitor and gamma electret detectors are given. 9 refs.; 6 figs.

1623 (INIS-mf—11002, pp 41-43) **External dose detection with solid detectors.** Kvasnichka, J. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Experimental and calculation techniques have been suggested for determinating the external gamma-radiation doses in the vicinity of a NPP. The total dose was measured with integral thermoluminescent detectors (TLD). The gamma-radiation from soil and due to secondary cosmic rays was calculated. The cosmic component in the natural background was determined with TLDs placed over surface of a lake. 1 fig.

1624 (INIS-mf—11002, pp 184-188) **Stationary dosimetric system STADOS.** Gaek, P.; Neuzhil, I.; Krotil, I. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A stationary dosimetric system is described including measuring instruments complex for the radiation conditions inspection both at certain points of the object and that of the gas/aerosol releases to the environment. STADOS system is designed on the basis of CAMAC complex and can be extended and modified in accordance with technological process changes and employed at quite different objects. It is able to register strictly the current radiation conditions by means of an automatic printing device. An automatic verification via remotely controlled reference sources ensures high system reliability.

1625 (INIS-mf—11002, pp 3-10) **Comparative measurements of gamma radioactive background in different shielded chambers with the use of Ge(Li) detector.** Shekherov, L.I.; Prodanov, Ya.D.; Stefanov, G.V.; Tsvetkov, O.S.; Gedeonov, L.I.; Golovlev, V.G.; Triumfov, N.G.; Flegontov, V.M. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

With the use of Ge(Li) detector with 75 cm/sup 3/ active volume gamma-spectra of the residual radiation background have been measured in five different shielded chambers located in three low-background laboratories: an underground one (120 m water equivalent), a country on-ground one (wooden building) and the on-ground laboratory of INRNP (a basement in a concrete building with 5 m water equivalent). In addition the gamma spectra of the natural radiation backgroun d in the mentioned chambers were measured with the absence of the shield. The nature and quantitative characteristics of the residual radiation background in these chambers have been identified. The residual background has been shown to result mainly from the radioactive emanation decay products and potassium-40. 11 refs.; 4 tabs.

1626 (INIS-mf—11002, pp 11-22) **Requirements to gamma-spectrometry methods of nuclear installation environment monitoring.** Knobus, B.; Zare, P.; Fitts, J. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Ge(Li) spectrometers have been applied for qualitative/quantitative radionuclide analysis at the extremely low radioactivity levels during nuclear installations operation. For data processing microcomputers in on-line and minicomputers in out-of-line regimes were employed. The results from the microcomputer with NIDAC

code pack are presented in 2 minutes after measuring and in 3-13 hours in case of calculations on the minicomputer. The described system is suitable both for solution of emission problems and standard monitoring. 8 refs.; 6 tabs.; 1 fig.

1627 (INIS-mf—11002, pp 23-35) **Express method of Cs-137 determination in environmental samples.** Radicheva, M.A. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A method for CS-137 determination has been suggested that is based on the use of complex ferro-ferricyanides of transition metals. This method had been approbated at Kozloduj NPP and IRT-2000 reactor in Sofia. A good agreement with the classic method (ceasium sedimentation in the form of Cs/sub 2/PtCl/sub 6/) was obtained for measurements of soil, river bed deposition, plant, milk powder and other samples. The described method is easily applicable, non-expensive, does not require high qualification personnel. The radiochemical part of the analysis without preliminary sample treatment takes 12-24 hours. 30 refs.; 5 tabs.; 3 figs.

1628 (INIS-SU—424, pp 48-56) **Measurement of primary ionization of relativistic charged particles in the RISK spectrometr streamer chamber.** Bannikov, A.V.; Behm, Ya.; Vertogradov, L.S. 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780011/JAW. (JINR-N—18-86).

In JINR rapid communications. Collection.

Procedure of extraction of information on ionization losses of particles from the data on streamer chamber track microstructure in the RISK spectrometer streamer chamber obtained on the automatic measuring system based on the AELT-2/160 cathode ray tube is described. The possibility of using average value of streamer diameter on a track measured directly on a film is proposed. It is used as a parameter making allowance for instabilities of streamer chamber systems and of photographic material parameters. The difference is observed between ionization losses of 38 GeV/c π/sup -/-mesons and antiprotons which agrees with theoretical estimates. The accuracy achieved of the ionization measurement is near to the theoretical limit.

1629 (INS—617) **Study of energy losses for 18 keV β-rays in a Langmuir-Blodgett thin film.** Kawakami, H.; Nisimura, K.; Ohshima, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jan 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750318/JAW.

This study is intended for understanding the energy loss effect in LB film. Arachidic acid, in the form of Cd salt, is used as material for the β-ray source and the film under investigation. Two different sources are prepared on resistive backing plates. Source A has two molecular layers in thickness, where part of Cd's is replaced with radioactive /sup 109/Cd. Source B is prepared by building up on the former one an additional two molecular layers of the acid with non-active Cd. KL/sub 2/L/sub 3/ spectra of Sources A and B are observed. Both spectra show the same shape around and above the peak while showing quite different structures below the peak. The spectrum of Source B has an enhanced shoulder at the lower energy side, indicating an energy loss in the additional two layers. Energy loss spectrum is obtained by deconvoluting the β spectrum of Source B with that of Source A. A sharp peak appears at the energy $\Delta E = 0$, which is the non-energy loss component with a probability of 75%. The energy loss spectrum has prominent peaks at $\Delta E \simeq 23$ eV and $\simeq 43$ eV, and possibly also at — 60 eV. The energy spacings among these peaks are nearly the same, suggesting that the 1st, 2nd and 3rd peaks correspond to 1-, 2- and 3-interactions of β-rays with molecules of the acid. The spectrum is fitted to estimate the probability of individual scatterings. Resultant probabilities are 18.9%, 5.9% and 0.7% for the 1st, 2nd and 3rd peaks, respectively. (Nogami, K.).

1630 (IPNO—84-03) **Study and realization of a gas regulation.** Bartol, F.; Auger, G.; Jouan, D.; Plagnol, E. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1984. 15p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752721/JAW.

The use of gas counters in nuclear physics needs to understand and well monitor the regulation mechanisms of gas pressure or gas mass introduced in the counters. The operation mode of a gas regulation device is briefly recalled. The development test results are described.

1631 (KEK—86-7) **Proceedings of the first workshop on solar neutrino detection.** Sakuda, Makoto; Suzuki, Y. (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Dec 1986. 182p. (In Japanese and English). (CONF-8608199—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750286/JAW.

From 1. workshop on solar neutrino detection; Oho, Ibaraki, Japan (29 Aug 1986).

The purpose of the workshop was to review this vital field of the solar neutrino physics and to search for new techniques for next generation detectors to cover full range of the solar neutrino spectrum. Reviews of the solar model, the matter oscillation and experimental status were given. Discussions were also focused on a radio chemical measurement and indium detectors. Progress reports of scintillation fibers and indium-loaded scintillators were presented. Possible new detectors to use low temperature techniques were also reported. Progress reports from the Kamioka experiment, the only one from the real world, covered their search for the solar neutrinos and the effect of the matter oscillation of atomospheric neutrinos.

1632 (KFKI—1987-25/K) **Application of Ge-spectrometry for rapid in-situ determination of environmental radioactivity.** Andrasi, A.; Nemeth, I.; Zombori, P. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). May 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700129/JAW.

The method of in-situ gamma-spectroscopic determination of environmental radioactivity was introduced in the environmental monitoring system of both the Central Research Institute for Physics and the Paks Nuclear Power Plant. Several semiconductor detectors (HpGe and Ge(Li)) were calibrated and tested for field measurements of natural and artificial radionucleides distributed on/in the soil. The method and its application is discussed, the way of calibration and some of the model calculations, and the main results of the measurements after the Chernobyl reactor accident are presented. 8 refs.; 6 figs.; 4 tables.

1633 (LAL—86-36) **Scintillating fibre detector in the UA2 upgrade programme.** Merkel, B. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Oct 1986. 11p. (CONF-8605164—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752736/JAW.

From 2. topical seminar on perspectives for experimental apparatus at future high energy machines; San Miniato, Italy (5 May 1986).

A study of a compact and cylindrical tracking detector based on the use of scintillating fibres is presented. A prototype has been built and tested with 40 GeV/c electrons and hadrons.

1634 (LPNHEP—86-02) **FCSIO: Fastbus Cable Segment Input Output.** Cerrito, L.; Lebbolo, H.; Tesseidre, A. (Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies). Mar 1986. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752707/JAW.

This device is intended to connect the cable port of a Fastbus module to the cable segment. It has been developed in the context of the project of the buffer memory HFB developed at the L.P.N.H.E. Paris VI et VII for the DELPHI Outer detector Read out system. Using the FCSIO, the Cable Port of a Fastbus module does not need to convert the normal ECL signals to the differential one and vice versa on the board. This is done on FCSIO, saving in this way, space and a quite complete (except for the alimentations) symmetry between the crate and the cable side on the module.

1635 **(LPNHEP—86-03) FPG: Fastbus Pattern Generator and Bus Configuration detector.** Cerrito, L.; Chorowicz, V.; Lebbolo, H.; Tesseidre, A. (Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies). Mar 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752708/JAW.

This module has been developed for the DELPHI-OUTER DETECTOR read out system environment. It is a Fastbus slave designed as a tool for syncronizing and monitoring a complex Fastbus system. FPG is a programmable pattern generator with front panel TTL output: six on lemo cable and 24 on flat cable. Its frequency can range between 67 KHz and 20 MHz. It can be programmed to generate a signal on occurency of a particular configuration of the crate bus.

1636 **(LYCEN—8670) Performances of large BGO crystals below 20 MeV.** Burq, J.P.; Chemarin, M.; El Mamouni, H. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Nov 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752737/JAW.

This paper presents the performances of large tapered BGO crystals to low energy photons of 6 to 20 MeV. The read-out of the crystals was made with large area photodiodes associated to shaping amplifiers.

1637 **(LYCEN-TH—8626) Contribution to the study of the electromagnetic BGO calorimeter of the L3 experiment on the LEP.** Lebrun, P. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Mar 1986. 148p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752711/JAW.

The present thesis deals with the study and the design of the electromagnetic calorimeter that will equip the L3 detector on the LEP collider. The originality of this set-up lies in the use of photodiodes coupled to large bismuth germanate oxide crystals. The energy resolution and the position resolution of calorimeter prototype were determined in the energy range from a few MeV to 50 GeV. An important effort was devoted to the design of electronics well-matched to the large area photodiodes readout and to covering of the wide dynamic range. The excellent resolution obtained at low energy (less than 1 GeV) makes the electromagnetic calorimeter well-adapted to the toponium spectroscopy.

1638 **(MPI-PAE/Exp.El.—177) Performance of a BaF/sub 2/ calorimeter with photodiode readout at energies between 60 MeV and 7 GeV.** Giehl, J.; Hauff, D.; Henneberg, J.M.; Lorenz, E.; Mageras, G.; Vogel, H. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Max-Planck-Institut fuer Chemie (Otto-Hahn-Institut), Mainz (Germany, F.R.). Abt. fuer Kernphysik; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.); Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Jun 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753316/JAW.

We report test results of a small BaF/sub 2/ calorimeter using incident beam energies between 60 MeV and 7 GeV. A readout scheme consisting of a combination wavelength shifter plate and silicon photodiode is employed. Measurements of the linearity, energy resolution for electromagnetic showers, electron/hadron separation and time resolution are presented.

1639 **(N—87-25983) Solar High-energy Astrophysical Plasmas Explorer (SHAPE). Volume 1: Proposed concept, statement of work and cost plan.** Dennis, B.R.; Martin, F.D.; Prince, T.; Lin, R.; Bruner, M.; Culhane, L.; Ramaty, R.; Doschek, G.; Emslie, G.; Lingenfelter, R. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1986. 98p. (NASA-TM—89258; NAS—1.15:89258). NTIS, PC A05/MF A01.

The concept of the Solar High-Energy Astrophysical Plasmas Explorer (SHAPE) is studied. The primary goal is to understand the impulsive release of energy, efficient acceleration of particles to high energies, and rapid transport of energy. Solar flare studies are the centerpieces of the investigation because in flares these high energy processes can be studied in unmatched detail at most wavelenth regions of the electromagnetic spectrum as well as in energetic charged particles and neutrons.

1640 **(N—87-26688) Reduction and scientific analysis of data from the charge-energy-mass (CHEM) spectrometer on the AMPTE/CCE spacecraft. Cumulative Semiannual progress report, August 1984-August 1987.** Gloeckler, G.; Hamilton, D.C.; Ipavich, F.M. (Maryland Univ., College Park (USA)). Aug 1987. 16p. (NASA-CR—181168; NAS—1.26:181168). NTIS, PC A02/MF A01.

The Charge-Energy-Mass (CHEM) spectrometer instrument on the AMPTE/Charge Composition Explorer (CCE) spacecraft is designed to measure the mass and charge-state abundance of magnetospheric and magnetosheath ions between 0.3 and 315 keV/e, an energy range that includes the bulk of the ring current and the dynamically important portion of the plasma sheet population. Continuing research is being conducted using the AMPTE mission data set, and in particular, that of the CHEM spectrometer which has operated flawlessly since launch and still provides excellent quality data. The requirted routine data processing and reduction, and software develpment continues to be performed. Scientific analysis of composition data in a number of magnetospheric regions including the ring current region, near-earth plasma sheet and subsolar magnetosheath continues to be undertaken. Correlative studies using data from the sister instrument SULEICA, which determines the mass and charge states of ions in the energy range of approximately 10 to 250 keV/e on the IRM, as well as other data from the CCE and IRM spacecraft, particularly in the upstream region and plasma sheet have also been undertaken.

1641 **(NRPB-R—208) Technical specification of the NRPB radon personal dosemeter.** Bartlett, D.T.; Bird, T.V. (National Radiological Protection Board, Chilton (UK)). Mar 1987. 7p. H.M. Stationery Office, London, price Pound3.00.

This document is a formal specification of the National Radiological Protection Board's radon personal dosemeter, which measures the time integral of the radon-222 gas concentration in its immediate environment independent of the temporal variation in this concentration.

1642 **(PB—87-227617/XAB) NBS (National Bureau of Standards) measurement services: neutron personnel dosimetry. Final report.** Schwartz, R.B. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Jul 1987. 47p. (NBS/SP—250/12). NTIS, PC A03/MF A01.

See also PB—87-174041; Also available from Supt. of Docs as SN003-003-02811-8; Library of Congress catalog card no. 87-619842.

Detailed procedures are given for calibration of neutron dosimeters and remmeters with californium neutron sources, both bare and moderated. Corrections for scatter, room-return, anisotropic neutron emission, and deviation from the inverse square law are discussed, and specific examples given. The uncertainties in arriving at the final value for the calibration factor are also discussed.

1643 **(RAL—87-011) Vertex detection and tracking at future accelerators.** Saxon, D.H. (Rutherford Appleton Lab., Chilton (UK)). Feb 1987. 27p. (CONF-870184—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752950/JAW.

From Workshop on future accelerators at high energies; La Thuile, Switzerland (7 Jan 1987).

Track and vertex reconstruction requirements at LHC and CLIC are considered. A more sophisticated tracking system expands both the range of physics to be studied and the confidence in event signatures. Event characteristics and accelerator environment dictate the techniques, with severe demands on an LHC detector at small radii. Solutions for central and forward tracking are developed, and multivertex reconstruction studied. Research and development needs are identified and limitations on luminosity defined.

1644 **(RAL—87-014) Time-of-flight neutron reflectometer for surface and interfacial studies.** Penfold, J.; Ward, R.C.; Williams, W.G. (Rutherford Appleton Lab., Chilton (UK)). Mar 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752949/JAW.

A time-of-flight neutron reflectometer constructed for surface and interfacial studies, and installed at the ISIS pulsed neutron source, is described. One of its important design features is its inclined incident beam, since this allows both liquid and solid surface phenomena to be investigated. Measurements are presented to show the performance of the instrument, and new representative results, which include studies of liquid surfaces, Langmuir-Blodgett films, and thin film multilayers, are included as illustrations of the scientific potential of the method.

1645 **(RAL—87-021) Measurement of short-lived particles at PETRA.** Saxon, D.H. (Rutherford Appleton Lab., Chilton (UK)). Apr 1987. 21p. (CONF-8703167—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752956/JAW.

From Joint meeting of the Swiss, German and Austrian Physical Societies; Zurich, Switzerland (18 Mar 1987).

The contribution of PETRA to the measurement of short-lived particles is reviewed with discussion of the detectors and analysis techniques. New results are presented on lifetimes of identified particles and the systematics of b-life measurement outlined. The first application of vertex-tagging to flavour separation is described.

1646 **(RAL—87-025) Calibration of slow neutron polarised beam instruments.** Felici, R.; Penfold, J.; Ward, R.C.; Williams, W.G. (Rutherford Appleton Lab., Chilton (UK)). Apr 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752957/JAW.

A new procedure for calibrating the efficiences of the polarisation sensitive components in slow neutron polarised beam instruments is described. The measurement of one flipping ratio and two shim ratios allows the effective polarisation, the spin flipping efficiency, and a depolarising shim efficiency to be determined unambiguously. Results of its application to the calibration of a neutron time-of-flight polarised beam reflectometer are presented.

1647 **(SAND—87-1270C) Thin-foil x-ray dosimeters with millisecond time response: Applications and fielding techniques.** McMurtry, W.M.; Fehl, D.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-8710117—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87012982/JAW.

From DNA conference on instrumentation for nuclear weapon effects testing; Arlington, VA, USA (6 Oct 1987).

This report consists of a collection of vugraphs accompanied by brief descriptions. The purpose of this report is to describe in some detail the construction and fielding techniques for the thin foil thermal dosimeters that we have developed for pulsed x-ray environments. We discuss first the construction of the gauge and its temperature sensor. Next, several laboratory calibration measurements are described. Third, we consider the thermoelectric circuit used in the field together with the signal calibrations. Data reduction is the subject of the fourth section, and we conclude with a list of future developments. 17 figs.

1648 **Radiation dose-rate meter using an energy-sensitive counter.** Kopp, M.K. (to Dept. of Energy). US Patent Application 6-942,651. 17 Dec 1986. 16p. Contract AC05-84OR21400. DE88000852 NTIS, PC A02/MF A01; GPO Dep. Order Number DE88000852/JAW.

A radiation dose-rate meter is provided which uses an energy-sensitive detector and combines charge quantization and pulse-rate measurement to monitor radiation dose rates. The charge from each detected photon is quantized by level-sensitive comparators so that the resulting total output pulse rate is proportional to the dose-rate. 3 figs.

1649 **Ionization monitor with improved ultra-high megohm resistor.** Burgess, E.T. (to Dept. of Energy). US Patent Application 6-916,345. 7 Oct 1986. 13p. Contract AC04-76DP00053. DE88000874 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000874/JAW.

An ionization monitor measures extremely small currents using a resistor containing a beta emitter to generate ion-pairs which are collected as current when the device is used as a feedback resistor in an electrometer circuit. By varying the amount of beta emitter, the resistance of the resistor may be varied. 5 figs.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 1503

1650 **(AERE-R—12076) Irradiation effects in commercial optical fibres.** Ransford, P.E.; Hooper, A. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Mar 1987. 23p. H.M. Stationery Office, London, price Pound 4.00.

The in-situ irradiation-induced attenuation of a number of commercially available multimode optical fibres has been studied as a function of temperature and dose-rate using ^{60}Co gamma-radiation. Silica fibres doped with germanium and phosphorus exhibited the lowest radiation sensitivity at doses $< 10^2$ Gy (10^4 rads) and plastic clad silica (PCS) fibres at doses greater than this, up to 10^6 Gy (10^7 rads). The differences in radiation response for temperatures in the range 0°C to 100°C and dose-rates of 10^2-10^3 Gy h^{-1} were small.

1651 (BNL—52082, pp 44-48) **General remarks on antiproton beams.** Poth, H. 7 May 1987. NTIS, PC A05/MF A01. Order Number DE87012851/JAW. (CONF-8608192—; AGS/EP/S—87-1).

From Summer workshop on antiproton beams in the 2-10 GeV/c range; Upton, NY, USA (18 Aug 1986).

Several topics related to antiproton beam momentum are outlined. These include: beam momentum vs. cms resolution, momentum analyses, energy losses on targets, beam purity and achievable luminosity. Plots of cms mass resolution vs. momentum and beam purity for various antiproton beams are shown.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 117, 146, 251, 252, 367, 412, 413, 677, 702, 703, 764, 1109, 1280, 1282, 1306, 1404, 1408, 1415, 1433, 1438, 1439, 1442, 1446, 1498, 1506, 1525, 1582, 2061, 2097, 2541, 2598

1652 **(DOE/ER/60522—1) Development and applications of photosensitive device systems to studies of biological and organic materials: Progress report for the period January 1, 1987-December 31, 1987.** Gruner, S.M.; Reynolds, G.T. (Princeton Univ., NJ (USA). Joseph Henry Labs.). Aug 1987. Contract FG02-87ER60522. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000895/JAW.

Overall goals for grant FG02-87ER60522 are to investigate the application of low light-level electro-optical imaging technologies for biological and materials applications. Specific accomplishments since the last progress report (5/27/87) include: Demonstration of time-resolved millisecond x-ray diffraction capability utilizing an image-intensified TV x-ray detector at a synchrotron source; Construction, software refinement and evaluation of a CCD-based x-ray detector; Evaluation of microfabricated high-resolution phosphors; New x-ray beam line development; Investigation of applications of image intensification to crystalloluminescence and bioluminescence; and Utilizing the low-light level technology, materials research was carried out on biomembranes and liquid crystals. These results are described.

1653 **(EPRI-NP—5407) Nonintrusive measurement of liquid film velocity and flow rate: Final report.** Lai, M.L.; Soom, A. (State Univ. of New York, Buffalo (USA). Dept. of Mechanical and Aerospace Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 69p. Research Reports Center, Box 50490, Palo Alto CA 94303. Order Number TI88920052/JAW.

A solution for the electromagnetic flowmeter equation is presented and solved numerically for particular magnetic fields and thin film velocity profiles. The overall behavior of two transducers is examined via a parametric study. The output of the calculated transducer is shown to be only weakly dependent on film thickness. Sensitivity depends on the gradient of the in-plane magnetic field. An experimental apparatus was designed and built. The flow velocity measurements with two prototype transducers were made over a range of Reynold's numbers. The results are in good quantitative agreement with the theory. The wall velometer provides robust, non-intrusive measurement of the mean film velocity. The possibility of non-intrusive flowrate measurement was examined. A purely electromagnetic transducer with two electrodes and an electromagnetic/resistive transducer with four electrodes were examined. A prototype transducer was constructed and tested. Supporting electronics were built. The film thickness measurements were in good agreement with numerical simulations. The flowrate meter output showed some dependence on film thickness. The overall behavior could be predicted from the simulations. The feasibility of this type of non-intrusive film velocity and flowrate measurement has been clearly demonstrated. 11 refs., 30 figs.

1654 **(IAEA-TECDOC—426) Troubleshooting in nuclear instruments.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1987. 291p. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88700117/JAW.

This report on troubleshooting of nuclear instruments is the product of several scientists and engineers, who are closely associated with nuclear instrumentation and with the IAEA activities in the field. The text covers the following topics: Preamplifiers, amplifiers, scalers, timers, ratemeters, multichannel analyzers, dedicated instruments, tools, instruments, accessories, components, skills, interfaces, power supplies, preventive maintenance, troubleshooting in systems, radiation detectors. The troubleshooting and repair of instruments is illustrated by some real examples. Figs and tabs.

1655 **(K/ETAC—8) Calibration of a laser-pumped, thermographic phosphor remote thermometry system.** Allison, S.W.; Cates, M.R.; Dowell, L.J.; Gillies, G.T.; Lutz, W.N.; Ritter, R.C. (Oak Ridge Gaseous Diffusion Plant, TN (USA). Enrichment Technology Applications Center; Virginia Univ., Charlottesville (USA). Dept. of Physics). Aug 1987. Contract AC05-84OT21400. 20p. (CONF-8611137—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000452/JAW.

From International congress on applications of lasers and electro optics; Washington, DC, USA (1 Nov 1986).

Remote thermometry via laser-induced fluorescence (LIF) of a thermographic phosphor (doped refractory oxide) is a sensitive and potentially high-precision technique of growing usefulness in thermal metrology. A typical LIF measurement system consists of detection, waveguide, and signal analysis hardware. The systematic errors due to each of these components must be evaluated in order to arrive at an overall error budget for the measurement. In this paper, we consider the problems arising in calibration and characterization of the instrumentation used to monitor a fluorescing Y_3O_3 : Eu phosphor. 8 refs., 10 figs., 1 tab.

1656 **(MLM—3452) Optimization of dilatometer test procedures.** Henderson, W.R.; Waker, D.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 14 Sep 1987. Contract AC04-76DP00053. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014998/JAW.

An investigation was conducted to determine the best methods for obtaining the most accurate and precise data from a Theta dual pushrod dilatometer. The dilatometer uses computer-acquired data for both temperature and differential expansion measurements. Various potential sources of error were examined to determine their actual effects. It as learned that the type of thermocouple, thermocouple location, ramp rate, method of data acquisition, statistical deviations of multiple sample runs, and measuring head temperature stability all had large effects on the data. In addition, the linear variable differential transformer, errors in measuring sample lengths, and errors in algorithms used for reference expansion had insignificant effects. These tests were based on sample expansions typically used in production glass-ceramic samples (50-250 x E-07 in./in./°C). 4 figs., 13 tabs.

1657 **(N—87-26326) Optical strain measurement system development. Final report.** Lant, C.T.; Qaqish, W. (Sverdrup Technology, Inc., Arnold Air Force Station, TN (USA)). Jul 1987. 15p. (NASA-CR—179646; E—3678; NAS—1.26:179646; CONF-8708110—22). NTIS, PC A02/MF A01.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

A laser speckle, differential strain measurement system has been built and tested for future applications in hostile environments. One-dimensional electronic correlation of speckle pattern movement allows a quasi-real time measure of strain. The system has been used successfully to measure uniaxial strain reaching into plastic deformation of a test specimen, at temperatures ranging to 450 C. A resolution of 16 microstrain is given by the photodiode array sensor pitch and the specimen to sensor separation. The strain measurement error is estimated to be +/-18 microstrain +/-3 percent of the strain reading. The upper temperature limit of the gauge is determined by air density perturbations causing decorrelation of the reference and shifted speckle patterns, and may be improved by limiting convective flow in the immediate vicinity of the test specimen.

1658 **(PNL-SA—14791) Noncontact temperature measurements of hot steel bodies using an electromagnetic acoustic transducer (EMAT).** Boyd, D.M.; Sperline, P.D. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 9p. (CONF-870691—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000560/JAW.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (21 Jun 1987).

A noncontacting sensor system for measuring the average internal temperature of hot steel objects has been developed. The system uses a pulsed ruby laser for the generation of the acoustic wave and a pulsed Electromagnetic Acoustic Transducer (EMAT) as the receiver in a through-transmission technique. The pulsed EMAT design has been successfully tested to 1300° Celsius on a nine-inch-long stainless steel sample. The system measures the time-of-flight of the acoustic wave, which is coupled with the part dimension to determine the average acoustic velocity. From a calibrated relationship between velocity and temperature, the average sample temperature is determined. 8 refs., 9 figs.

1659 **New method for measuring fluid densities using the Taylor dispersion experiment.** Matthews, M.A.; Akgerman, A. (Texas A & M Univ., College Station). *International Journal of Thermophysics;* **8**: No. 3, 363-373(May 1987). Contract AC22-84PC70032.

The density of a pure fluid or a fluid mixture is of fundamental importance in the design of equipment for fluid processing and in the development of theory describing thermodynamic and transport properties of the liquid state. A new experimental technique for measuring fluid densities is presented, which is based on the well-known Taylor dispersion experiment for measuring mutual diffusion coefficients. The equipment and working equation are both simple, yet experimental results show that the method is accurate to at least 0.1%. An analysis of errors indicates that the accuracy could be improved to 0.01%. This new technique is of particular virtue since it can be used to obtain simultaneous measurements of the fluid density and diffusion coefficient of a solute in the fluid, using data from a single experiment.

1660 **Remnant field detector.** Visser, A.T. (to Dept. of Energy). US Patent Application 6-934,518. 24 Nov 1986. 15p. Contract AC02-76CH03000. DE88000843 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000843/JAW.

An apparatus for qualitatively detecting remnant magnetic fields in matched pairs of magnet cores is described. Equal magnitude and oppositely oriented magnetic flux is induced in the magnet cores by oppositely wound primary windings and current source. Identically wound secondary windings generate output voltages in response to the induced flux. The output voltages generated should be of equal magnitude and opposite polarity if there is no remnant field in the cores. The output voltage will be unequal which is detected if either core has a remnant field. 1 fig.

1661 **Motor current signature analysis method for diagnosing motor-operated devices.** Haynes, H.D.; Eissenberg, D.M. (to Dept. of Energy). US Patent Application 6-913,193. 30 Sep 1986. 24p. Contract AC05-84OR21400. DE88000863 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000863/JAW.

A motor current noise signature analysis method for remotely monitoring the operating characteristics of an electric motor-operated device such as a motor-operated valve. Frequency domain signal analysis techniques are applied to a conditioned motor current signal to distinctly identify various operating parameters of the motor driven device from the motor current signature. The signature may be recorded and compared with subsequent signatures to detect operating abnormalities and degradation of the device. This diagnostic method does not require special equipment to be installed on the motor-operated device, and the current sensing may be performed at remote control locations, e.g., where the motor-operated devices are used in inaccessible or hostile environments. 6 figs.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 1321, 1434

1662 **(DOE/EV/06194—3-Rev.3) DOE explosives safety manual.** (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC. Office of Operational Safety). Aug 1987. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000831/JAW.

This manual is applicable to all DOE facilities engaged in operations of development, manufacturing, handling, storage, transportation (on site), processing, or testing of explosives, or assemblies containing explosives. It contains guidelines and standards for these operations in order to safeguard personnel and to prevent property damage. Criteria established by this manual are specific to high explosives but also apply to propellants and pyrotechnics when these materials can undergo explosive reactions. The standards of this manual deal with the operations involving explosives and the safe management of such operations. Design criteria for facilities used in conjunction with explosives operations are addressed only indirectly. Design criteria for explosives facilities are contained in DOE 6430.1, "General Design Criteria Manual." It is not intended that existing physical facilities be changed arbitrarily to comply with this manual's provisions, except as required by law. Facility conditions determined to be noncompliant shall be resolved among the DOE Field Operations Office (FOO), Program Office, and the Office of Operational Safety (OOS). The standards are presented as either mandatory or advisory. Mandatory standards, denoted by the words "shall," "must," or "will," are requirements that must be followed unless written authority for deviation is granted as an exemption by the DOE. Advisory standards denoted by "should" are standards that may be deviated from with a waiver granted by facility management. 2 refs.

1663 **(LA-UR—87-3169) Jet initiation of PBX 9502.** McAfee, J.M. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 18p. (CONF-8707122—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000493/JAW.

From DEA conference; Schrobenhausen, F.R. Germany (1 Jul 1987).

This report details the progress of an effort to determine the quantitative aspects of the initiation of PBX 9502 (95% TATB, 5% Kel-F 800) by copper jets. The particular jet used was that produced by the LAW warhead (66-mm diameter, 42° angle cone, copper-lined, conical shaped charge). Fifteen experiments, in various configurations, have been fired to define the essential parameters for quantitatively measuring the jet performance and initiation of bare PBX 9502. 7 refs., 8 figs.

1664 **(LA-UR—87-3170) Deflagration to detonation in HMX under high confinement.** McAfee, J.M.; Campbell, A.W.; Asay, B.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 28p. (CONF-8707122—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000492/JAW.

From DEA conference; Schrobenhausen, F.R. Germany (1 Jul 1987).

The deflagration-to-detonation behavior of HMX confined in steel tubes was studied by means of x radiography, light emission, and various pin techniques. Unlike most reported experiments, the HMX bed was ignited by driving a piston (initially at rest and in contact with the HMX) into the bed with the pressure generated from burning, low-density HMX on the opposite side of the piston. Because a gasless igniter is used to start the burning of the low-density HMX, the piston has a relatively smooth initial motion. Analysis of the data from these experiments gives a rather detailed picture of the DDT process under these conditions. 2 refs., 19 figs.

1665 **(LA-UR—87-3171) Response of propellant to hypervelocity attack.** Asay, B.W.; Ramsay, J.B.; Campbell, A.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 24p. (CONF-8707122—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000491/JAW.

From DEA conference; Schrobenhausen, F.R. Germany (1 Jul 1987).

This study was undertaken to examine the behavior of heterogeneous gun propellants when they are impacted by shaped-charge jets. In the immediate area surrounding the impact point, the pressure is believed to be above the detonation pressure of the full-density propellant. However, a detonation does not necessarily occur, and if it does, the detonation does not necessarily propagate. This is a function of grain size, web, perf pattern, jet diameter, propellant failure diameter, and composition. The investigators hope to eventually understand the mechanism and physics of the failure of detonation in these systems. This report summarizes the initial work performed in support of the study. The results presented here formed the groundwork for a more specific effort, which is continuing. 18 figs., 1 tab.

4502 Nuclear

REFER ALSO TO CITATION(S) 392, 1739, 1745, 1786, 1996

1666 **(AD-A—183394/6/XAB) Soviet short-range nuclear forces: flexible response or flexible aggression. Student essay.** Smith, T.R. (Army War Coll., Carlisle Barracks, PA (USA)). 23 Mar 1987. 59p. NTIS, PC A04/MF A01.

This essay takes a critical look at Soviet short-range nuclear forces in an effort to identify Soviet capabilities to fight a limited nuclear war with NATO. From an analysis of Soviet military art, weapon-system capabilities and tactics, the author concludes that the Soviets have developed a viable limited-nuclear-attack option. Unless NATO reacts to this option, the limited nuclear attack may become favored Soviet option and result in the rapid defeat of NATO.

1667 (AD-A—995497/5/XAB) **Operations order serial number 1-52.** (Test Aircraft Unit, Bergstrom AFB, TX (USA)). 1 Aug 1952. 65p. (TAU—132.4.2). NTIS, PC A04/MF A01.

1668 (DOE/DP—0046) **Defense Programs.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Defense Programs). Aug 1987. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000172/JAW.

There are six major program areas at DP: Weapons Activities, Nuclear Materials Production, Defense Waste and Transportation Management, Nuclear Safeguards and Security, Verification and Control Technology and Classification. This brochure outlines these.

1669 (SAND—87-0889) **An excitation-term modification for a certain class of electromagnetic aperture-coupling problems.** Riley, D.J.; Bacon, L.D. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000260/JAW.

A simple technique is presented for modifying electromagnetic aperture-coupling integral equations that are based on an infinite-ground-plane assumption, to partially account for excitation modifications which result from plane-wave interaction with a side of an actual three-dimensional scatterer. The technique is based on incorporating the solution for a conducting wedge into the integral equations. Results are presented for coupling to coaxial connectors which are more consistent with experimental observations. 5 refs., 13 figs.

1670 (SAND—87-2058) **Electrostatic discharge primer.** Turner, C.D. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001582/JAW.

One of the many electromagnetic-related environments which a nuclear weapon is designed to survive without degradation of reliability is electrostatic discharge (ESD). Although there are many possible mechanisms by which a nuclear weapon could be subject to an electrostatic discharge, the two which to date have received the most attention and are explicity addressed in nuclear weapons development documents are personnel and helicopter static electricity discharge. The purpose of this document is to describe the nature of these specific threats and to describe the various specifications and testing procedures which are applied to assure a design tolerant of these threats. 13 refs.

1671 (USGS/MAP/I—1872) **Map showing surface features induced by underground nuclear explosions at Pahute Mesa, Nevada Test Site, Nye County, Nevada, April 1976 through December 1983.** Covington, H.R. (Geological Survey, Denver, CO (USA)). 1987. Contract AI08-76DP00474. 13p. US Geological Survey, Open File Service, Box 25425, Denver Federal Center, Denver, CO 80225. Order Number TI88000203/JAW.

The location and types of surface features resulting from underground nuclear explosions are documented in this map. (ACR)

4503 Explosion Detection

REFER ALSO TO CITATION(S) 2001

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

REFER ALSO TO CITATION(S) 1298

5001 Basic Studies

REFER ALSO TO CITATION(S) 1318, 1390

1672 (ANL—87-32) **A review of parameterizations of microphysical processes in clouds for application in models of regional atmospheric deposition.** Lee, I.Y.; Hong, M.S. (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000451/JAW.

The literature on parameterizations of cloud microphysical processes was reviewed to examine the theoretical bases of those parameterizations and to evaluate their applicability to regional models. New parameterizations were produced by multiple regression upon the solution fields derived from simulations of a cloud model incorporating sophisticated microphysics. The currently available rates for cloud microphysical interactions were generally derived under the assumption that the size distribution functions for various hydr ;meteors are given. Such parameterizations must therefore be applied with caution because the spectral evolution of various types of hydrometeors in reality varies significantly during the stages of cloud development. Uncertainties exist in assigning values for aerodynamic properties such as the bulk collection efficiency, and the growth processes for various types of ice crystals are not well enough known for accurate multiphase cloud-microphysics parameterizations. The new parameterizations, in general, compare favorably with those currently available and are more efficient and applicable to regional models. The largest discrepancies occur in the autoconversion rates, whereas the accretion rates agree closely when the assumed collection efficiencies in other formulas are smaller than unity. 56 refs., 16 figs., 3 tabs.

1673 (ANL/ER-TM—87-1, pp A.1-A.8) **Processing and deposition of pollutants by convective storm systems.** Daum, P.H. (Brookhaven National Lab., Upton, NY). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The primary objective of PRocessing of Emissions by Clouds and Precipitation (PRECP) program is to provide essential information for the quantitative description of chemical wet deposition as a function of air-pollution loadings, geographic location, and atmospheric processing. This information is to be used in the definition of the relation between pollutant emissions and subsequent deposition for analysis of the policies directed towards control of acidic precipitation. For the 1988 PRECP-VI field campaign, convective storms will be studied to: 1) create a comprehensive data base on precipitation scavenging by convective storms for detailed evaluation of the RADM Scavenging Module, 2) determine inflow and outflow composition (including surface precipitation) of convective systems to estimate the extent to which species are processed and/or removed by convective systems, 3) measure the concentrations of gaseous hydrogen peroxide in and around convective systems, especially vertical profiles from the boundary layer to approximately 6 km, 4) investigate whether significant materials are transported to the upper troposphere by convective systems, and 5) estimate the fraction of air appearing in the anvil outflow regions that has been entrained through the sides of the system.

1674 (ANL/ER-TM—87-1, pp B.1-B.5) **Multiple-doppler radar analysis of midwestern convective storms.** Westcott, N.; Ackerman, B. (Illinois State Water Survey, Champaign). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The proposed research will: 1) examine the influence of the horizontal and vertical air motions within an existing storm on the formation of new cells and adjacent clouds, and 2) evaluate the role of the new developments and their union with the pre-existing segments in the evolution and maintenance of the storm. The vertical transport of mass within the individual cells and within the storm as a whole will be examined. This study will be set in the context of the synoptic scale dynamics and will examine the role of the mesoscale thermodynamic and kinematic conditions in the storm evolution. In addition, an attempt will be made to address the microphysical aspect of cloud interaction and the feedback between microphysical and dynamic processes.

1675 (ANL/ER-TM—87-1, pp C.1-C.5) **Anvil water mass/chemistry study.** Heymsfield, A.J. (National Center for Atmospheric Research, Boulder, CO). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

It is the objective of this study to quantify the proportion of storm condensate which is advected into the anvils of PRECP storms and to understand how entrainment of environmental air affects the total storm condensate and the proportion which is transported into the anvil. Transport of pollutants into the anvil will have a major effect in redistribution of them and on the chemical reactions which take place. Thus, this study will provide important new information for analysis of pollutant transport. Also, in-situ measurements of chemical species in the anvil and in storm environments, coupled with this study, will provide further insight for PRECP experiments.

1676 (ANL/ER-TM—87-1, pp D.1-D.4) **Cloud transport experiment.** Kropfli, R.A. (Environmental Research Labs., Boulder, CO). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objective of this experiment is to measure the amount of material vented out of the convective boundary layer and transported into the upper levels of the troposphere by convective storms. A new technique that employs dual-polarization Doppler radar allows this measurement to be performed over the entire storm in several minutes. More conventional techniques that utilize aircraft releases of trace gases such as sulfur hexafluoride are able to sample only a fraction of the cloud in longer time periods. This measurement is made possible by a new dual-polarization technique which allows the detection of artificial tracers of air motion, chaff, within moderately high reflectivity regions of convective clouds. (Kropfli and Moninger, 1986). The technique exploits the great disparity between the circular depolarization ratio (CDR) of natural hydrometeors and the CDR of chaff. (CDR is te ratio (expressed in dB) of power backscattered as right hand circular polarization to power backscattered as left hand circular polarization when the incident wave is right hand circular.) Naturally occurring hydrometeors generally scatter as though they were slightly deformed spheres with CDR values between -40 dB and -15 dB.

1677 (ANL/ER-TM—87-1, pp E.1-E.3) **Precipitation efficiency and washout by precipitation through storm inflow.** Knight, C.A. (National Center for Atmospheric Research, Boulder, CO). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objectives of this experiment are: 1) to understand the mechanisms responsible for the precipitation efficiency of storms, with particular reference to the factors the govern the size distributions and concentrations of hydrometeors found in the updraft, and 2) to estimate direct washout of chemical constituents from storms' inflows by the action of precipitation falling through the inflow in the lower levels. The tools needed to approach these two objectives are 1) multiple-Doppler radar coverage to obtain three-dimensional wind fields, 2) a surface precipitation collection network for taking time-resolved precipitation samples for chemical analysis, and 3) a penetrating aircraft - almost necessarily the South Dakota T-28, for cloud physics measurements in the lower levels where the recycling is most important.

1678 (ANL/ER-TM—87-1, pp F.1-F.4) **Sequential chemistry of rain experiment in 1988 (SECOR-88).** Bowersox, V. (Illinois State Water Survey, Champaign). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objectives of this study are: 1) to examine the time variation of wetfall chemistry both along and lateral to the motion of convective raincells to determine the nature of the dominant scavenging processes for the various species measured; 2) to look for differences between ions which have different precursors (for example, NO_3 from gaseous HNO_3, SO_4 from gaseous SO_2 and small particle SO_4, NH_4 from small particle SO_4, and Ca from large particles); 3) to apply statistical techniques of source identification; 4) to provide data for verification of convective scale models for modules of larger models. There is no data set available on the small time and space scale that the authors propose to sample. Such small scale data will be essential to validate detailed convective cell models to determine if the chemistry components of the models are reasonable. The data set may also provide information about new approaches to the modeling effort.

1679 (ANL/ER-TM—87-1, pp H.1-H.3) **Thunderstorm outflow-outflow and outflow-environment interactions.** Emmitt, G.D.; Garstang, M. (Simpson Weather Associates, Inc., Charlottesville, VI). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The primary objective o the proposed field study is to observe the locations of new cells in a mesoscale convective complex and relate those sites to the convergence and vertical stability fields as measured by a surface network, Doppler radar, and microwave sounders. Four specific goals are identified within this general objectives: 1) observe the thermodynamics and kinematics of thunderstorm outflows in the boundary layer (Doppler radar, PAM); 2) observe the interactions of these outflows with one another and the extra-storm environment (Doppler radar, PAM); 3) observe the initiation of new visual and/or radar detectable cells in relationship to the convergence fields; and 4) relate the triggering, as well as non-triggering, zones to the: a) strength of the convergence, b) stability of the air being lifted, c) duration and spatial persistence of the lifting, and d) maintenance of boundary layer support for the triggered cells.

1680 (ANL/ER-TM—87-1, pp I.1-I.2) **Doppler lidar measurement of thunderstorm outflow characteristics.** Hardesty, R.M. (Environmental Research Labs., Boulder, CO). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objective of this study is to determine the boundaries and flow characteristics of air transported into the boundary layer by convective storms. Specifically, by scanning transverse to an approaching gust front or outflow region, the lidar will be used to: 1) characterize the depth of the outflow, 2) determine the propagation speed of the gust front, and 3) investigate the flow characteristics within the outflow.

1681 (ANL/ER-TM—87-1, pp J.1-J.4) **Precipitation augmentation for crops experiment (PACE).** Changnon, S.A.; Czys, R.R. (Illinois State Water Survey, Champaign). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

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The proposed field effort and research are within the context of the overall PACE goals and objectives as set forth in the PACE Program Plan. The goals of the Precipitation Augmentation for Crops Experiment (PACE) are: 1) to determine the precipitation alterations attainable in various growing season weather conditions; 2) to determine the impacts on all facets of agricultural from rain alterations that could be established; and 3) to discern the ultimate socio-economic and environmental desirability of the weather alterations. The specific objectives of PACE are: 1) to execute carefully designed field experiments involving cloud modification and rain enhancement in the central agricultural region of the US; 2) to document the alteration of cloud dynamics and other physical responses from modification; 3) to develop conceptual and numerical models to guide the experimentation in the ultimate transfer of the technology if developed; 4) to identify changes in area precipitation brought about by modification of warm season precipitation elements; and 5) to determine any undesirable effects of modification treatments.

1682 (ANL/ER-TM—87-1, pp K.1-K.3) **Lagrangian studies of convective airflow structure.** Marwitz, J. (Univ. of Wyoming, Laramie). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objective of this study is to attempt a Lagrangian study in moderate cumulus congestus clouds. The basis of the Lagrangian scheme is to generate on each cloud pass a mean three-dimensional vector of the air motion over a portion of the cloud qualified by pre-set criteria, and to then navigate the aircraft to the predicted position of the air parcel for the subsequent penetration. The selection criteria can be a combination of cloud-physics and air motion parameters, plus air-chemistry parameters if the measurements can be taken with sufficiently rapid response time. These criteria are objectively evaluated, with possible branches and options in the decision path, by the on-board computer. At the same time the vector flow field in averaged and its variability determined. If the variability is not excessive (the motion field is relatively smooth) then an extrapolation of the air trajectory is made by the computer. At the same time, continuously updated navigation information is provided to the pilot for the return penetration. Repetitions of this procedure provide a series of cloud penetrations which constitute an intermittent sampling (approximately 4-8 min intervals) of a given cloud parcel along its trajectory.

1683 (ANL/ER-TM—87-1, pp L.1-L.2) **Use of hailstones as cloud water composition probes.** Knight, N.C.; Knight, C.A. (National Center for Atmospheric Research, Boulder, CO). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objective of this study is to use hailstones as cloud water composition probes to study the relationship between chemical content and growth temperature of cloud droplet chemistry. In severe convective storms hail grows primarily in the strong updrafts where there is probably relatively little dilution through entrainment. Strong updrafts are also inaccessible to aircraft customarily used as instrument platforms in atmospheric chemistry. Those hailstones large enough to fall to the surface may provide information not otherwise obtainable about cloud droplet chemistry. Preliminary chromatographic analyses have demonstrates statistically significant relationships between chemical content and growth temperature. The analyses have involved chloride, nitrite, sulfate, and oxalate. The layered structure of hailstones also may provide information as to the chemistry in different parts of the storm. The analyses also suggest that the freezing process may retard reactions in some chemical species.

1684 (ANL/ER-TM—87-1, pp M.1-M.3) **Transports of inert tracers by organized convection using dynamical models.** Moncrieff, M.W. (National Center for Atmospheric Research, Boulder, CO). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objectives of this study are: 1) to diagnostically use numerical simulations of organized convection (particularly squall lines) to determine the deep and rapid transport of inert tracers in the troposphere, and 2) to use theoretical models to determine transport laws which are substantially different from diffusive mixing-length ideas. A basic study will be to determine how initial concentrations of inert tracers are redistributed by squall lines, using the detailed velocity fields obtained from numerical simulations. One of the important properties of squall lines, which are characteristic of a highly-sheared environment, is that they consist of organized uni- or multi-cellular convective elements with well-organized downdrafts and updrafts. In conceptual terms, the planetary boundary layer of a depth of order one kilometer is peeled off and transported to the upper troposphere by the updrafts, while the lower tropospheric air is transported to the boundary layer by the downdrafts; the troposphere is therefore effectively overturned. In certain cases, the mid-tropospheric air is not substantially displaced in the vertical. It follows that the transports are more advective (Lagrangian) than diffusive in form. Moreover, the squall line inflow and outflow properties can be determined.

1685 (ANL/ER-TM—87-1, pp N.1-N.3) **Investigation of the microphysical basis for wet removal of pollutants in convective storms.** Lamb, D. (Pennsylvania State Univ., University Park). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

Specific objectives of this study are: 1) to identify the likely mechanisms of precipitation formation and chemical fractionation in specific cases studied observationally by this joint cloud chemistry and cloud physics program, 2) to estimate the relative efficiencies with which various trace substances (particularly, S(IV) and S(VI) compounds, NO_3^-, and NH_4^+, metals) are removed from these same storm systems, and 3) to categorize, using whatever data become available, the dominant removal processes according to meteorological regimes as a way of facilitating the eventual parameterization of the complicated cloud processing mechanisms.

1686 (ANL/ER-TM—87-1, pp O.1-O.5) **Convective cloud glaciation and haze.** Czys, R.R. (Illinois State Water Survey, Champaign). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

This study proposes to investigate convective cloud glaciation within the context of rural air mass contamination, to begin to investigate differences in the conversion of water to ice, to determine possible effects on prcipitation growth, and to provide microphysical information needed to more completely understanding the cycling of atmospheric pollution by summertime convection. This study has several specific objectives: 1) measure the conversion of water to ice (rate, habit, concentration, etc.) with respect to cloud temperature, vigor, maturity; 2) determine initial ice concentrations and habit preferences according to the absence, presence, maturity and chemical composition of the developing haze; 3) to test the hypothesis for secondary ice-production, determine alternate processes and identify compensating mechanisms in the event of splinter suppression; and 4) to correlate all microphysical observation with atmospheric pollutants and haze intensity to discern any dependency of glaciation on haze. The goal of this study is to improve the understanding of ice origin, initial growth and evolution in relation to precipitation production and efficiency.

1687 (ANL/ER-TM—87-1, pp P.1-P.6) **Studies of the impact of various types of mesoscale convective precipitation systems upon pollutants within the planetary boundary layer.** Lyons, W.A.; Pielke, R.A. (R*Scan Corp., Minneapolis, MN). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The overall effort is aimed at achieving a better understanding of the ways how one of the two major portions of a convective storm's outflow (the sub-cloud downdraft) interacts with pollutants within the pre-existing polluted boundary layer. Individual goals

that will be pursued include: 1) compilation of a detailed catalog for each significant Mesoscale Convective Precipitation System (MCPS) which passes within 100 km of the test site during the program, indicating its type, movement, morphological structure, rainfall pattern, gust front and mesohigh characteristics, volume of air generated in the mesohigh formation, etc; 2) preparation of space/time sections from the surface pollutant and meteorological measurements showing the relationship of these data to the storm mesosystem; 3) evaluation of the performance of various wet removal schemes, ranging from the purely conceptual models, to simplistic scavenging coefficients, and modules currently under development for RADM (this will involve interaction with various investigators).

1688 (ANL/ER-TM—87-1, pp Q.1-Q.3) **In-situ observations of cloud top dynamics and entrainment.** Stith, J.L.; Poellot, m. (Univ. of North Dakota, Grand Forks). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The overall objective of the proposed investigation is to obtain in situ observations of cloud top dynamics and entrainment and to use these measurements to address the following topics: 1) the trajectory of air parcels after they rise through the tropopause or equilibrium level, 2) the extent of the cloud-environment mixing and the resulting in-cloud lapse rates, 3) the dependence of the mixing on vertical wind shear and the temperature profile above the equilibrium level, and 4) the magnitude of the mass exchange between the stratosphere and the troposphere. The extent to which these questions can be answered will depend substantially on the number of cloud samples that can be obtained. This will be limited by not only the frequency of thunderstorm occurrence during the observational period but also by safety constraints.

1689 (ANL/ER-TM—87-1, pp R.1-R.3) **Tracer techniques for studies of chemical transport and transformations in convective clouds.** Stith, J.L.; Poellot, M. (Univ. of North Dakota, Grand Forks). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objectives of this investigation are: 1) to determine the amounts of boundary layer air transported upward by convective storms, 2) to determine the active entrainment and detrainment regions in large convective storms, 3) to determine the amounts of middle and upper tropospheric air which are transported to the lower troposphere by these storms, 4) to establish the chemical transformation which occur during the transport and mixing processes described in 1) through 3), and 5) to support the cooperative PRECP studies with the University of North Dakota (UND) Citation research facility.

1690 (ANL/ER-TM—87-1, pp S.1-S.5) **Polarimetric radar studies of rainfall and hydrometeor phase discrimination for applications in cloud physics and chemistry.** Aydin, K.; Seliga, T.A. (Pennsylvania State Univ., University Park). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The proposed research is a continuation of the authors radar meteorological and cloud physics studies using the dual polarization differential reflectivity (ZDR) technique (Seliga and Bringi, 1976). Case studies comparing radar estimates of rainfall rates with ground-based estimates of raindrop size distributions and rainfall rates will be undertaken. These will ensure that radar-derived spatial and temporal variability of rainfall are correct. Once the validity of the radar rainfall measurements is established, the radar data will be used to gain a better understanding of precipitation mechanisms and the microclimatology of storms and their relationships to air pollution scavenging processes. Although combined (ZH, ZDR) measurements have been shown to give very good evidence of water-ice phase discrimination in storms, much theoretical and experimental work remains to be done on this subject. Additional computation and modeling studies of the backscattering properties of various hydrometeor ice habits are required; these should lead to improved schemes for characterizing ice habits in addition to discriminating between water and ice phases. These efforts will be coordinated with aircraft observations of hydrometeors. Major focus using (ZH, ZDR) measurements will be to examine icewater storm morphology which will contribute to improved understanding of the cloud physical processes which govern storm evolution.

1691 (ANL/ER-TM—87-1, pp T.1-T.3) **Use of the boundary layer wind profiler.** Strauch, R.G. (Environmental Research Labs., Boulder, CO). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objective of the Mobile Wind Profiler Measurement Program is to measure the environmental winds from near the surface to about 7 km altitude in real time for experiment planning. These measurements can be made every hour to determine the background wind and wind variances and covariances during the course of the experiment. In addition, the profiler will give measurements of the vertical distribution of backscattered power which can be used to determine the temporal behavior of the daytime inversion height. Wind profiles can be measured in 15 min in special modes of operation.

1692 (ANL/ER-TM—87-1, pp U.1-U.3) **Ground level nitrate and sulfate particulate concentration measurements.** Davis, B.L. (South Dakota School of Mines and Technology, Rapid City). Jun 1987. NTIS, PC A06/MF A01. Order Number DE87010796/JAW.

In 3CPO: cloud chemistry and cloud physics organization: coordination document.

The objectives of this study are to provide surface concentration measurements of nitrate and sulfate compounds. The Institute of Atmospheric Sciences is currently operating a triple path denuder (TPD) which has been constructed under National Science Foundation support specifically for the measurement by x-ray diffraction (XRD) methods of sulfate and nitrate particulate concentrations (Davis et al., 1987). It is possible to also measure gas phase concentrations on back-up denuders and from analysis of the denuder coating materials providing the sampling period is of several hours duration. The objectives of using such a device for the PRECP Project would be to quantitatively evaluate the concentrations of nitrate and sulfate compounds (Davis et al., 1982) which can act as centers of condensation in convective cloud systems and which can modify the droplet size distributions in such clouds.

1693 (DFVLR-MITT—87-07) **Documentation of the regional climate model based on FITNAH.** Frenzen, G.; Heimann, D.; Wamser, M. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.); Karlsruhe Univ. (T.H.) (Germany, F.R.). Meteorologisches Inst.; Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Oberpfaffenhofen (Germany, F.R.). Inst. fuer Physik der Atmosphaere; Hannover Univ. (Germany, F.R.). Inst. fuer Meteorologie und Klimatologie). Apr 1987. 92p. (In German). NTIS (US Sales Only), PC A05. Order Number DE87753265/JAW.

The three-dimensional non-hydrostatic model FITNAH (developed at the Technical University of Darmstadt) was modified to serve as a working model for studies during the F.R.G. climate research program. The documentation compiles the model and describes the computer code and the user interfaces. It also includes selected test cases.

1694 (KFK-PEF—12-Vol.2, pp 347-365) **Observed phenomena during the TULLA-experiment.** Fiedler, F.; Adrian, G.; Hugelmann, C.P. (Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Meteorologie und Klimaforschung; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

Observations from the measuring phase of March 21, 1985 from the TULLA-experiment are used to demonstrate some mete-

orological influences for the occurrence of distributions of air pollutants. The aims of the experiment were especially devoted to study the influences of complex terrain on the lower atmosphere. Surface inhomogeneities produce pressure disturbances in the lee and at the windward side of mountains, which dominate the air flow in the lowest levels. Taking four different directions of the largescale atmospheric flow surface winds are studied by simulations with a mesoscale model.

1695 (KFK-PEF—12-Vol.2, pp 397-407) **Simulation of the long range transport of air pollutants for a TULLA episode.** Nester, K.; Baer, M.; Fiedler, F. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.; Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Meteorologie und Klimaforschung). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The model DRAIS was developed to simulate the transport and dispersion of pollutants in a mesoscale area. It is able to calculate the spatial and temporal distribution of the pollutant concentrations and the dry deposition at ground level in an irregular terrain. The model equation and the boundary condition at ground level in a terrain following coordinate system are given. Concentration calculations of SO/sub 2/ for the area of Baden-Wuerttemberg have been carried out using the emission and meteorological data of the TULLA experiment from March 25, 1985.

1696 (KFK-PEF—12-Vol.2, pp 409-418) **Brightness-temperature maps of Baden-Wuerttemberg derived from satellite images.** Gossmann, H.; Saurer, H.; Scheer, M.; Scherer, D. (Freiburg Univ., Germany, F.R. Inst. fuer Physische Geographie). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

In the present project brightness-temperature maps of Baden-Wuerttemberg and patterns of cloud-surface temperature above Baden-Wuerttemberg are derived from images of the NOAA-weather-satellite taken during some cloudless days in fall 1985 and during the TULLA-project, respectively.

1697 (KFK-PEF—12-Vol.2, pp 473-486) **Flow around conifers: Deposition of droplets by turbulent diffusion - the influence of orography.** Ruck, B.; Schmitt, F. (Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Hydromechanik). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The transport of small droplets at low wind speeds is caused by convective transport mechanisms and by turbulent diffusion. Combining laser Doppler anemometer flow and turbulence field measurements with visualization studies of the deposition probability confirmed the conventional deposition theories, which assumed direct correlations between turbulent diffusion and deposition probability.

1698 (PNL—6279-Vol.5) **Hanford Meteorological Station computer codes: Volume 5, The TOWER computer code.** Buck, J.W.; Andrews, G.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001610/JAW.

The Hanford Meteorological Station (HMS), operated by Pacific Northwest Laboratory, archives wind, dry bulb temperature, and soil temperature data gathered each hour from the 410-ft meteorological tower. These data include measurements of wind speed and wind direction for seven heights, eight dry bulb temperatures, and three soil temperatures. The TOWER computer code is used to archive those measurements and apply quality assurance checks to the data. The code accesses an input file, which contains the previous archive's date and hour, and an output file, which contains tower weather observations for the current month. A data entry form consisting of 25 fields is included in the program. The fields must be filled in by the user. The information entered is appended to the monthly file, which provides an archive for the tower data gathered hourly. This volume describes the implementation and operation of the TOWER computer code at the HMS.

1699 (PNL-SA—14946) **Radiation and surface energy budgets for a Colorado valley.** Whiteman, C.D.; Allwine, K.J.; Hubbe, J.M.; Foote, H.P.; Orgill, M.M.; Fritschen, L.J. (Pacific Northwest Lab., Richland, WA (USA); Washington Univ., Seattle (USA)). May 1987. Contract AC06-76RL01830. 5p. (CONF-870864—9). NTIS, PC A02. Order Number DE88000102/JAW.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

This article will summarize the radiation budget and the surface energy balance in the valley on September 25, 1984, emphasizing the physical interpretation of the measurements. This article will also describe a method being developed to estimate the variation of radiation and energy budget parameters for a large area of the valley based on observations at the five measurement stations.

1700 (PNL-SA—15015) **Valley mass and energy budgets computed from model simulations.** Bader, D.C. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 3p. (CONF-870864—10). NTIS, PC A02. Order Number DE88000104/JAW.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

One goal of the Department of Energy's Atmospheric Studies in Complex Terrain (ASCOT) program is to evaluate the contributions to the mass and energy budgets in the steady-state nocturnal valley wind system. A preliminary calculation of the mass budget for the Brush Creek, Colorado valley was made by Whiteman and Barr (1986) from tethersonde measurements made one night during the summer of 1982. More extensive measurements were taken during the 1984 Brush Creek field experiments to provide a more detailed evaluation of the terms in the valley mass and thermal energy budgets (Horst et al., 1987). This paper describes numerical model experiments designed to perform similar budget calculations of an idealized version of the Brush Creek valley and too explore some of the topographical influences on these calculations. 9 refs., 2 figs.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 99, 110, 223, 226, 230, 231, 459, 619, 620, 950, 951, 1039, 1052, 1061, 1107, 1113, 1307, 1327, 1530, 1531, 1907, 1962, 1967, 1969, 1970, 1973, 1974, 1975, 1976, 1977, 1979, 1985, 2003

1701 (ANL/CNSV-TM—173, pp 167-173) **Controlling dioxins.** Kemp, C.C. (Canruf Co., Toronto, Ontario). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

Representative dioxin and furan emissions data from solid-waste-fired facilities are presented. The probable sources for these emission are reviewed and it is concluded that incomplete combustion is their cause. Means for minimizing incomplete combustion are described. Performance of facilities designed and operated for low dioxin and furan emissions is reviewed and the impact of these emissions on the public health is discussed. It is concluded that these dioxin and furan emissions are not a threat to the public health.

1702 (BMFT-FB-T—86-231) **Minimum ventilation rates as a function of the use and the frequency of use of rooms. Final report.** Wegner, J.; Schlueter, G.; Angerer, C.; Meyer, H.D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene). Dec 1986. 167p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87753250/JAW.

From a hygienic view-point optimum indoor air quality can be characterized as the complete absence of pollutants. The most important sources of such pollutants are reviewed, amongst them those entering a room from outside, those generated by man and his activities and those emanating from different materials such as building materials, furnishing, cleansing and polishing agents. In view of achieving acceptable indoor conditions all emissions have to be kept as low as possible. Carbon dioxide and body odors as well as pollutants, the concentrations of which cannot be reduced to non-relevant levels by product control, should be eliminated by ventilation measures. However, such measures should not exceed a given limit, since in order to minimize energy consumption, air exchange rates have to be kept at a minimum. As a result of the investigations, it is concluded that the minimum ventilation rate should be derived from the acceptable CO/sub 2/ concentration. The concentrations of all other pollutants (e.g., formaldehyde) should be limited by product control or source removal. With 75 refs., 10 tabs., 19 figs.

1703 **(DFVLR-FB—87-17) Investigation of large-scale impact of air pollution components on forest ecosystems in Bavaria.** Paffrath, D.; Peters, W. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.); Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Oberpfaffenhofen (Germany, F.R.). Inst. fuer Physik der Atmosphaere). 8 May 1987. 177p. (In German). NTIS (US Sales Only), PC A09. Order Number DE87753277/JAW.

On the basis of large-scale concentration distributions of SO/sub 2/, NO/sub x/, ozone and acidity forming particles over Bavarian forest damage areas, measured by aircraft and van typical average impact distributions have been obtained. Furthermore, the impact of polluted fog on the forests in the Fichtelgebirge was investigated. The results show that no direct effects of gaseous SO/sub 2/ and NO/sub x/ can be detected, however, serious forest damage seems to prevail in areas where the average ozone concentration is highest. A clear influence of polluted fog on forest disease could not be found. With 72 figs., 15 tabs., 60 refs.

1704 **(DOE/EH—0053-Vol.2) The environmental survey manual: Appendices A, B, and C.** (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC. Office of Environmental Audit). Aug 1987. 236p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88000254/JAW.

The purpose of this manual is to provide guidance to the Survey and Sampling and Analysis teams that conduct the one-time Environmental Survey of the major US Department of Energy operating facilities. This volume contains appendices on: (1) criteria for data evaluation; (2) checklists and lines of inquiry; and (3) health and safety plan for on-site survey activities. (ACR)

1705 **(ECN—87-118) Modelled historical concentrations and depositions of ammonia and ammonium in Europe.** Asman, W.A.; Drukker, B.; Janssen, A.J. (Netherlands Energy Research Foundation, Petten; Rijksuniversiteit Utrecht (Netherlands). Inst. voor Meteorologie en Oceanografie). Aug 1987. 23p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

A survey of historical ammonia (NH/sub 3/) emissions is presented for individual European countries (excl. the USSR and Turkey). From 1870 to 1980 the annual total NH/sub 3/ emission from livestock wastes, fertilizer application and the fertilizer industry has increased from 2.2 to 4.7 Mt of NH/sub 3/. A Lagrangian long-range transport model is used to calculate the change in concentration and deposition of ammonia and ammonium (NH/sub 4//sup +/) in Europe over the same period. It is shown that the percentage of increase in concentration and deposition during this period varies regionally. The modelled increase of NH/sub 4//sup +/ concentration in precipitation is shown not always to be in agreement with historical measured concentrations. 5 figs., 6 tabs., 13 refs.

1706 **(KFK-PEF—12-Vol.2) 3. PEF status colloquium Karlsruhe, March 10-12, 1987.** Horsch, F.; Filby, W.G.; Fund, N.; Gross, S.; Hanisch, B.; Kilz, E.; Seidel, A. (comps.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Apr 1987. 427p. (In German). (CONF-8703151—Vol.2). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW.

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

During the 10-12th of March 1987 the Third Status Report of the Project 'European Research Centre for Air Pollution Control Measures' took place in Karlsruhe. This paper presents progress reports on the following topics: research into atmospheric dispersion, conversion and deposition of airborne pollutants; development and optimization of industrial-technical processes to reduce or avoid emissions; providing instruments and making recommendations to the industrial and political sectors and air pollution effects on human health. 31 of 32 papers have been documented separately in data bases.

1707 (KFK-PEF—12-Vol.2, pp 367-380) **Temporal and spatial allocation of SO/sub 2/-, NO/sub x/- and VOC-emissions in Baden-Wuerttemberg.** Boysen, B.; Friedrich, R.; Mueller, T.; Obermeier, A.; Voss, A. (Stuttgart Univ., Germany, F.R. Inst. fuer Kernenergetik und Energiesysteme). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

During the TULLA-measuring-period the IKE has elaborated an emission inventory in a spatial allocation of 1 km x 1 km and a temporal allocation of one hour for the substances SO/sub 2/ and NO/sub x/.

1708 (KFK-PEF—12-Vol.2, pp 381-395) **Composition of air particulate materials originating from chemical conversion of SO/sub 2/ and NO/sub x/.** Wieser, P.; Schreiber, H.; Greiner, W. (Hohenheim Univ., Stuttgart, Germany, F.R. Inst. fuer Physik). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

Groundbased and airborne (aircrafts) cascade miniimpactors (5 stages) and air filtration devices were exposed to sample aerosol particles before, during and after the TULLA campaign (spring 1985). Besides small sulfate and large nitrate particles, air particulate matter containing chlorides were identified as nitrate carriers, carbonaceous particles as sulfate carriers.

1709 (KFK-PEF—12-Vol.2, pp 419-434) **Concentration and deposition of sulfur compounds in the FRG resulting from sulfur emissions in Europe.** Halbritter, G.; Braeutigam, K.R.; Sardemann, G.; Schuler, A.; Wiesmann, F.J. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Abt. fuer Angewandte Systemanalyse). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The European emission inventory for SO/sub 2/ and NO/sub x/ for 1982, which was generated at KfK/AFAS, shows some interesting structural differences between emission sources in East-European countries, the FRG itself, and West-European countries. These differences concern the amount of emission per person and the distribution of emission to different stack heights. The relevance of different emission sources for long range transport is demonstrated by calculating the frequency of trajectories passing an area and reaching a specified region (catchment area of trajectories).

1710 (KFK-PEF—12-Vol.2, pp 435-445) **Identification of products of the chemical/photochemical conversion of biogenic hydrocarbons with anthropogenic airborne pollutants (O/sub 3//NO/sub 2/).** Jay, K.; Stieglitz, L. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Heisse Chemie). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The monoterpenes α-pinene, β-pinene, camphene and limonene were irradiated in air in the presence of NO/sub 2/. At high NO/sub 2/ concentration (6 mg/m/sup 3/) products from the addition of atomic oxygen at the terpene are predominant, while at low NO/sub 2/ concentration (60 μg/m/sup 3/) mainly the ozonolysis products were received.

1711 (KFK-PEF—12-Vol.2, pp 447-457) **Simulation of the photooxidation of biogenic hydrocarbons of forests in consideration of the impact of NO/sub x/ and anthropogenic hydrocarbons.** Nolting, F.; Zetzsch, C. (Fraunhofer-Institut fuer Toxikologie und Aerosolforschung, ITA, Hannover, Germany, F.R.). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

For an assessment of the ozone forming potential of biogenic hydrocarbons (terpenes) a method of determining ozone reactivities is developed. Several reference compounds are employed simultaneously, using this new method of evaluation.

1712 (KFK-PEF—12-Vol.2, pp 459-472) **Formation of sulfate and nitrate containing particles and droplets in the atmosphere.** Dlugi, R.; Jordan, S.; Maetzing, H.; Manegold, S. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Lab. fuer Aerosolphysik und Filtertechnik 1). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

In laboratory experiments, the heterogeneous oxidation of sulfur dioxide and nitrogen dioxide was investigated on synthetic salt and soot particles as well as on fly ash from coal fired power plants. The measured reaction rates provide a basis for a model of atmospheric chemistry and transport, especially in areas under anthropogenic influence. Preliminary to the TULLA-experiment, sulfate and nitrate concentrations were measured as function of time and height at the Mannheim airport. During daytime, the surface concentrations of these spezies exhibit marked fluctuations which are mutually correlated. At KfK, the temporal behaviour of the sulfate concentration in fog water was determined. The observed formation rate of sulfate can be explained theoretically, if catalytically active metal ions are taken into account.

1713 (KFK-PEF—12-Vol.2, pp 487-498) **Development of a semi-continuous monitor to measure sulfuric acid and total sulfates in clean air regions.** Israeel, G.W.; Boehm, R. (Technische Univ. Berlin, Germany, F.R. Fachgebiet Luftreinhaltung). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

An instrument was developed that allows the separate and semi-continuous monitoring of ambient sulfuric acid and sulfates. The sulfate concentration is measured continuously with a flame photometric detector. The sulfuric acid is first absorbed and accumulated in a thermodiffusion denuder and subsequently analysed by the same detector. With a time resolution of 30 min. the detection limit of the instrument amounts to 1.0 μg/m/sup 3/ for sulfate and 0.1 μg/m/sup 3/ for the sulfuric acid. The automated and microcomputer controlled instrument is designed for use in forests.

1714 (KFK-PEF—12-Vol.2, pp 637-652) **Development of technical and economical strategies for emission reduction measures for sulphur dioxide and nitrogen oxides from stationary sources in Baden-Wuerttemberg and member countries of the European Community.** Rentz, O.; Haasis, H.D.; Morgenstern, T.; Remmers, J.; Schons, G. (Karlsruhe Univ., T.H., Germany, F.R. Inst. fuer Industriebetriebslehre und Industrielle Produktion). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

Within this project strategies for reducing emissions of sulphur dioxide and nitrogen oxides from stationary sources in Baden-Wuerttemberg and member countries of the European Communities are developed. For these strategies, possible shifts of the optimal energy supply and industrial structure are determined and analysed. For solving the conflict between energy conversion and emission reduction optimizing energy-environmental-models are used.

1715 (KFK-PEF—12-Vol.2, pp 653-663) **Cost-effectiveness-analysis of strategies to reduce SO/sub 2/- and NO/sub x/-emissions in urban areas.** Mattis, M.; Boysen, B.; Friedrich, R.; Voss, A. (Stuttgart Univ., Germany, F.R. Inst. fuer Kernenergetik und Energiesysteme). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

On the example of the city of Stuttgart costs and effectiveness of several methods to reduce the SO/sub 2/ and NO/sub x/-emissions are investigated. Therefore the present and the future SO/sub 2/- and NO/sub x/-emissions are calculated. They are split up into four sectors: power plants, plants $\geq$ 1 MW/sub th/, plants $<$ 1 MW/sub th/ and transportation. Furthermore the calculations give the results for each of Stuttgart's city-districts separately. Subsequently measures for the reduction of SO/sub 2/- and NO/sub x/-emissions in all sectors are identified and analyzed. To determine the costs and the reduction of the emissions the application of abatement-methods is simulated. Suggestions for an environmental policy as efficient as possible are deduced from the result of these calculations.

1716 (KFK-PEF—12-Vol.2, pp 665-674) **Evaluation of instruments for realising efficient measures for emission control.** Friedrich, R.; Mattis, M.; Voss, A. (Stuttgart Univ., Germany, F.R. Inst. fuer Kernenergetik und Energiesysteme). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

Different approaches to environmental protection such as standards, charges, marketable permits, subsidies, offset policies and voluntary agreements will be investigated with regard to the efficiency, that means the ability to lower the emission with the least costs possible. Using scenarios of the future development of the SO/sub 2/- and NO/sub x/-emissions in Baden-Wuerttemberg, the use of different instruments is simulated.

1717 (KFK-PEF—12-Vol.2, pp 675-695) **Anthropogenic dusts in ambient air of Baden-Wuerttemberg: Physico-chemical analysis and toxicologic assessment.** Spurny, K.R.; Marfels, H.; Koerdel, W.; Otto, F.; Mueller, J.; Fritsche, U.; Glaser, U.; Angerer, G.; Boehm, E. (Fraunhofer-Institut fuer Umweltchemie und Oekotoxikologie, Schmallenberg, Germany, F.R.; Fraunhofer-Institut fuer Systemtechnik und Innovationsforschung, ISI, Karlsruhe, Germany, F.R.). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

On 7 selected sampling sites in the country of Baden-Wuerttemberg the year evolutions of concentrations of anthropogenic atmospheric aerosols are measured. The hazardous aerosol substances

are described and characterized by chemical analysis of the total aerosol, by particle size distributions, by particle form and morphology and in the case of fibrous aerosols also by the element analysis of single particles. In aerosols concentrations of fibrous particles as well as of inorganic and organic substances are determined. For the health risk evaluation from the total aerosol as well as from different toxic groups of chemical substances, toxic effect models, threshold limits and biological in vitro-evaluating methods (e.g. mutagenity, cytotoxicity, cell transformation and phagocytosis tests) are used. The project is in the starting phase. Sampling devices are tested, sampling sites are selected and equipped and in the laboratory biological in situ tests are improved.

1718 **(NP—8770021) Bromine/lead ratios and organic halogen and lead compounds in aerosols and car exhaust.** Baumann, H. (Regensburg Univ. (Germany, F.R.). Naturwissenschaftliche Fakultaet 4 - Chemie und Pharmazie). 1986. 378p. (In German). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88770021/JAW.

A trace analysis of the bromine and lead content of environmental aerosols, car exhaust, and rain samples was carried out by an isotope dilution analysis using mass spectroscopy. For a comparative analysis, also thallium and chlorine concentrations were measured in clean air regions. Using gas chromatography, organic halogen and lead compounds were measured in car exhaust using a microwave plasma detector for element-specific measurements.

1719 **(PB—87-208351/XAB) Development of a sampling system for surface dust-borne contaminants.** Ruby, M.G.; Roberts, J.W.; Boubel, R.W.; Lewis, R.G. (Environmetrics, Seattle, WA (USA)). Jul 1987. 17p. NTIS, PC A02/MF A01.

A useful sampling technique should have a known and reproducible removal rate of dust on various surfaces and be able to achieve a relatively constant efficiency at different loadings of surface-dust accumulation. In addition, the procedure should be able to collect and measure the low- and medium-volatility organics expected to be found on dust particles. Finally, the data collected should be capable of being compared to the actual dust uptake by a test subject. The paper reports on the development of a sampler designed to meet these objectives.

1720 **(PB—87-208799/XAB) PCB (polychlorinated biphenyl) trial-burn report for the US EPA (Environmental Protection Agency) Combustion Research Facility liquid-injection incinerator system.** Lee, J.W.; Backhouse, T.H.; Ross, R.W.; Waterland, L.R. (Acurex Corp., Jefferson, AR (USA)). Jul 1987. 104p. NTIS, PC A06/MF A01.

The report describes a trial burn of polychlorinated biphenyl (PCB) laden oil and No. 2 fuel oil injected into the liquid incinerator at the U.S. EPA Combustion Research Facility. Destruction and Removal Efficiencies (DREs) in excess of 99.99999% (40CFR 761.70) were achieved, far exceeding the requirement of 99.9999 for the PCB (Aroclor) were achieved in all test cases. Hydrochloric acid removal efficiencies generally exceeded 99.9%. Other emission rates of organic compounds listed in RCRA Appendix VIII were tested and reported.

1721 **(PB—87-209029/XAB) Acid aerosol transport episodes in Toronto, Ontario.** Thurston, G.D.; Waldman, J.M. (New York Univ., NY (USA). Inst. of Environmental Medicine). Jul 1987. 18p. NTIS, PC A02/MF A01.

Authors used recently developed equipment to continuously monitor levels of H_2SO_4, NH_4HSO_4 and $(NH_4)_2SO_4$ concentrations in the ambient air outside Toronto, Ontario. These data were combined with 48-hour isobaric air mass back-trajectories ending in Toronto on each of the four days with highest acid (and sulfate) aerosol levels. The air masses with highest acid levels were found to have first passed over the SO_2 source region of the U.S. and then across the Great Lakes to Toronto. The role of ammonia as a modulator of aerosol acidity for eastern U.S. cities but not for Toronto (where the Great Lakes serve as ammonia sinks) is also discussed.

1722 **(PB—87-209359/XAB) Pollutant sampler for measurements of atmospheric acidic dry deposition.** Knapp, K.T.; Durham, J.L.; Ellestad, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 7p. (EPA—600/J-86/382). NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 20, No. 6, 633-637(1986).

An acidic-pollutant sampler for dry-deposition monitoring was designed and evaluated in laboratory and field studies. The system, which is modular and simple to operate, samples gaseous HNO_3, NH_3, SO_2 and NO_2 and particulate $SO_4(-2)$, $NO_3(1-)$ and $NH_4(1+)$ and is made of Teflon to minimize trace reactive gas sorption. Particles greater than about 2 micrometers are removed with a cyclone. A transition-flow reactor (TFR) Teflon tube contains a Nylon liner for collection of a constant fraction of gaseous HNO_3 and a Nafion liner for collection of a constant fraction of NH_3. Excellent results were obtained in week-long runs with parallel sampling. In the first seven of these week-long runs the average difference between samples for gaseous HNO_3 was 4.6% with a standard deviation of only 3.7. In the same sampling runs, the average difference for particulate sulfate was 3.0% with a standard deviation of only 1.4.

1723 **(PB—87-210068/XAB) Directory of acid rain researchers and research users in New England, 1986 (revised). Special report (Final).** Kaynor, E.R. (Massachusetts Univ., Amherst (USA). Water Resources Research Center). Jan 1987. 64p. (UMAWRRC-SPEC—1). NTIS, PC A04/MF A01.

See also PB—87-214326.

This report provides background data on 123 acid rain and acid deposition researchers and on 39 users of acid-rain and acid-deposition research results in New England. Included in each entry is name, affiliation, address, telephone number, academic background, acid-rain-related specialties, current research, and key research interests. The report is part of an ongoing attempt by the Massachusetts Executive Office of Environmental Affairs to increase knowledge of and information exchange between professionals and citizens working in fields related to the problems of acid rain and acid deposition in New England.

1724 **(PB—87-212338/XAB) Collaborative research and health effects of environmental pollutants. Final report.** Bromberg, P.A. (North Carolina Univ., Chapel Hill (USA)). Jul 1987. 41p. NTIS, PC A03/MF A01.

The report is designed as an overview of more than five years of collaborative work intended to: (1) Provide EPA scientists with a ready means of access to University faculty and facilities and to enhance the intensity and frequency of interactions between EPA and UNC scientists; (2) Enrich the scientific milieu for EPA scientists; (3) Perform collaborative research in areas relevant to EPA's mission, especially in the air program; (4) Undertake research that could not be readily accomplished by EPA with its existing personnel - both in the area of development and application of techniques, and in the performance of research; (5) Provide access to diseased as well as normal human subjects, including children, in order to study sensitive as well as normal populations challenged with inhaled pollutants in highly controlled environmental exposure chambers.

1725 **(PB—87-212684/XAB) Determination of Henry's law constants of selected priority pollutants.** Warner, H.P.; Cohen, J.M.; Ireland, J.C. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Jul 1987. 18p. (EPA—600/D-87/229). NTIS, PC A02/MF A01.

The Henry's law constants (H) for 41 selected priority pollutants were determined to characterize these pollutants and provide information on their fate as they pass through wastewater treatment systems. All experimental values presented for H are averages of two or more replicates. Calculated values are based on data from many published sources. Many calculated results correspond closely to the experimental values, several deviate signifi-

cantly, and no values could be calculated for some compounds due to insufficient data.

1726 **(PB—87-212882/XAB) Development of an indoor-air-pollution-source emissions data base.** Reist, P.C.; Reaves, J.C.; White, J.B. (North Carolina Univ., Chapel Hill (USA). School of Public Health). Jul 1987. 9p. NTIS, PC A02/MF A01.

This paper discusses the design, structure, and theory of a microcomputer-based relational data base created to archive and retrieve published information concerning sources of indoor air pollutants. The data base is designed to be used by researchers, architects, policy makers, and others as a research aid to provide indoor-air-pollution source data for estimating emissions or predicting health effects.

1727 **(PB—87-212916/XAB) Destruction of organic contaminants by catalytic oxidation. Report for August 1985-July 1986.** Ashworth, R.A.; Palazzolo, M.A.; Tichenor, B.A. (Radian Corp., Research Triangle Park, NC (USA)). Jul 1987. 14p. NTIS, PC A02/MF A01.

This paper discusses the effectiveness of two catalytic systems in destroying specific organic compounds (jet-fuel components, chlorinated solvents). (NOTE: Catalytic incineration is used to destroy volatile organic compounds contained in air emissions from a variety of industrial processes.) The test-vapor streams consisted of low concentrations (3 to 200 ppmv) of mixtures which represented emissions from air strippers used to treat contaminated groundwater at U.S. Air Force bases. One system employed a metal-oxide catalyst in a fluidized bed. The other system used a fixed-bed proprietary catalyst, supplemented with UV light and ozone injection. Destruction efficiencies for the fluidized-bed reactor were between 97 and 99% at sufficiently high catalyst temperatures (500 C). Mixture composition, air-to-gas ratio, and space velocity affected destruction efficiency minimally. Destruction efficiencies for the UV-catalytic oxidizer ranged from 16 to 67% without ozone addition. With ozone, complete oxidation of the text mixture components was achieved, but high concentrations of several unidentified reaction products was observed.

1728 **(PB—87-212973/XAB) Inventory of chlorophenol use in the forest-products industry and investigation of related emissions of chlorinated dibenzodioxins and dibenzofurans. Final report.** Chinkin, L.R.; Weir, B.R.; Latimer, D.A. (Systems Applications, Inc., San Rafael, CA (USA)). May 1987. 152p. (SYSAPP—87/078). NTIS, PC A08/MF A01.

The report is primarily a statewide inventory of the amount of chlorophenols used as fungicides and wood preservatives in California's forest-products industry. The homologs used are predominately the penta-and tetra-chlorophenols and their water-soluble derivatives. Approximately 944 tons of the chlorophenols are used annually in approximately 40 facilities. The preservatives are applied by spray or dip or by injection under pressure. The authors also estimated the quantities of airborne fugitive emissions of chlorinated dibenzodioxins and dibenzofurans produced upon incineration of treated wood products, as well as emissions of these compounds contained as contaminants in the commercial preparations.

1729 **(PB—87-213898/XAB) Review and evaluation of recent literature relevant to occupational exposure - sulfuric acid.** Sevin, I.F.; Soucek, L.S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Criteria Documentation and Standards Development). Jun 1981. 45p. NTIS, PC A03/MF A01.

See also PB—83-101741.

New information on the effects of sulfuric acid is reviewed in an updated supplement to the 1974 NIOSH criteria document accompanying the recommended exposure standard. In 1974, a permissible exposure limit of 1 milligram (mg) sulfuric-acid mist per cubic meter (m^3) of air as a time-weighted average was recommended. Issues arising since that time include the use of catalytic converters and acid rain. New information on sampling and analysis, work practices and engineering controls, and toxic effects reported in humans and animals exposed to sulfuric-acid is reported. Accidental ingestion of sulfuric-acid still occurs, probably as a result of improper labeling. Animal studies on mucociliary clearance of sulfuric- acid have yielded inconsistent results. These inconsistencies are attributed to differences in species or age, aerosol size, or relative humidity. Rats are unaffected by sulfuric-acid even in high concentrations, whereas monkeys are quite sensitive. Larger aerosols of respirable size are more lethal to guinea-pigs than are smaller aerosols, but the smaller aerosols cause more severe pulmonary damage. Toxicity of sulfuric-acid is not increased by simultaneous exposure to other air pollutants.

1730 **(PB—87-213963/XAB) National dioxin study: Tiers 3, 5, 6, and 7.** (Environmental Protection Agency, Washington, DC (USA). Monitoring and Data Support Div.). Feb 1987. 208p. (EPA—440/4-87/003). NTIS, PC A10/MF A01.

See also PB—86-232857.

This report contains the results of an investigation by the U.S. Environmental Protection Agency to determine the extent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) contamination in the environment. The report presents the findings and conclusions from four of the seven tiers (Tiers 3,5,6, and 7). These four tiers are: Tier 3 sites where 2,4,5-trichlorophenol (2,4,5-TCP) or its derivatives were formulated, blended, and packaged. Tier 5 sites where suspected contaminated pesticides were commercially applied; Tier 6 sites where certain other chemical processes could inadvertently form 2,3,7,8-TCDD; and Tier 7 background soil and fish sites. More than 4,000 samples from 862 sites nation-wide were collected and analyzed for this investigation. Sampled media included soil, sediment, fish, and various animal and plant tissues. The report also presents discussions of the environmental fate processes and health assessments related to 2,3,7,8-TCDD exposure. Finally, the report describes the quality-assurance program implemented to meet the objectives of the study.

1731 **(PB—87-214037/XAB) Development of a static sampler for the measurement of suspended particulates in the ambient atmosphere. Final report.** Aitken, R.J.; Gibson, H.; Lynch, G.; Vincent, J.H.; Mark, D. (Institute of Occupational Medicine, Edinburgh (UK)). Feb 1987. 54p. (TM—87/02). NTIS, PC E06/MF E06.

A project was carried out to develop an instrument for sampling aerosols in the ambient atmosphere in a manner relevant to health effects. The approach adopted was to simulate the nature of human exposure. The development of the instrument was based on previous research into the sampling of aerosols in workplaces. The final prototype instrument aspirates air at 30 1/min through a single circular orifice in a sampling head, the main feature of which is its continuous rotation about a vertical axis. Thus, representative sampling of the inspirable fraction is achieved.

1732 **(PB—87-214326/XAB) Recent and ongoing acid-deposition research in New England - 1986. Special report (Final).** Kaynor, E.R. (Massachusetts Univ., Amherst (USA). Water Resources Research Center). Mar 1987. 59p. (UMAWRRC-SPEC—2). NTIS, PC A04/MF A01.

See also PB—87-210068.

This report provides abstracts or short synopsies of 98 ongoing or recently completed research projects on topics related to problems associated with acid deposition in New England. Included are topic, name, and affiliation of investigators, principal funding source, and a description of the work completed or being undertaken with findings if available. Entries are topically listed within 7 categories: (1) Atmospheric Processes and Precipitation, (2) Aquatic Effects, (3) Terrestrial Effects, (4) Cultural Materials Effects, (5) Watershed Studies, (6) Public Health Effects, and (7) Acid Mitigation Efforts. Also included is an index of investigators and an index of topics.

1733 **(PB—87-218723/XAB) Benefits of air pollution control in California. Volume 2. Final report.** Chestnut, L.G.; Peterson, D.C.; Miller, C.; Adams, R.M.; Rowe, R.D. (Energy and Resource Consultants, Inc., Boulder, CO (USA)). Dec 1986. 585p. NTIS, PC A25/MF A01.

The objective of the study was to estimate the economic benefit of controlling air-pollution emissions in California. The focus of the study was to use the best available literature, data,

methods, and judgement to estimate as accurately as possible the economic benefits of emission control. The study is restricted to the San Diego, South Coast, San Joaquin, and San Francisco Air Basins of California. The study comprises five alternative emission-control scenarios. For each of these scenarios, pollutant emissions, ambient air quality, air pollution impacts, and economic measures of the impacts are estimated and compared. The study encompasses pollution impacts to human health, agriculture, materials, forests, and visibility. The control scenarios include particulate matter, nitrogen oxide, sulfur oxide, lead, and reactive organic gas-emission estimates. One of the study scenario comparisons, compares actual conditions in 1979 to estimates of conditions in 1979 with 1960 level emission controls. The estimate of the economic benefit of this scenario is $11.9 billion per year.

1734 **(PB—87-218749/XAB) Technical assistance document for monitoring total reduced sulfur (TRS) from kraft pulp mills. Final report.** Winberry, W.T. (Engineering-Science, Inc., Cary, NC (USA)). Dec 1985. 382p. NTIS, PC A17/MF A01.

This document supports enforcement personnel in determining whether a total reduced sulfur (TRS) continuous emission monitoring (CEM) system is operating properly after initial compliance, in order to assure continuous compliance of Kraft pulp mills with TRS standards. The Kraft process, the applicable NSPS (Subpart BB), common TRS CEM Systems, performance specification tests, and QA/QC are covered. Evaluation forms covering all aspects of the TRS CEM system are provided.

1735 **(PB—87-218764/XAB) Acid deposition in Maryland: a report to the Governor and General Assembly (1986). Annual report.** (Maryland Power Plant Research Program, Annapolis (USA)). Jan 1987. 343p. (PPRP/AD—87-1). NTIS, PC A15/MF A01.

The Power Plant Research Program coordinates Maryland's acid-deposition research and reports research results annually. The report evaluates several major topic areas including transport and chemistry of acid deposition, its potential impacts on the State's streams and fish, possible impacts on terrestrial resources such as crops and forests and on materials, the ability of energy-conservation programs to reduce emissions of acid-forming pollutants, and mitigation techniques for neutralizing acid waters.

1736 **(PB—87-221016/XAB) Industrial hygiene walk-through survey report of Universal Woods, Inc., Louisville, Kentucky.** McCammon, C.S.; Krishnan, E.R.; Goodman, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 13 Apr 1987. 20p. (IWS—157.20). NTIS, PC A02/MF A01.

The potential for exposure to acrylates or methacrylates was investigated during a walk through survey at the Universal Woods facility in Louisville, Kentucky. Thirteen employees have potential contact with acrylates in the wood-finishing operations at this location. Depending on the specific end use of the wood product, as many as five coat applications were used during the finishing step. To apply these coats, two reverse roll coaters, a direct roll coater, and two curtain coaters were used. It was recommended that gloves be mandatory for operators handling top coats, fillers, and adhesives. Respiratory protection was recommended for all operations involving methylene chloride.

1737 **(PB—87-222063/XAB) Industrywide studies report of an in-depth survey at Copolymer Rubber and Chemical Corporation, Baton Rouge, Louisiana.** Krishnan, E.R.; Fajen, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 8 May 1987. 55p. (IWS—147.22B). NTIS, PC A04/MF A01.

An in depth industrial hygiene survey was conducted at the Copolymer Rubber and Chemical Corporation located in Baton Rouge, Louisiana. The facility produced styrene-butadiene rubber and nitrile-butadiene rubber by continuous emulsion polymerization. The ultimate use of this product was for the manufacture of tire and rubber products. The authors recommend that leaking pumps which can present a potential for 1,3-butadiene exposure in the tank farm and recovery areas should be controlled through the use of dual mechanical seals. Employees assigned to maintenance tasks should use respirators with organic vapor cartridges.

1738 **(PNL—6100-Pt.3) Pacific Northwest Laboratory: Annual report for 1986 to the DOE Office of Energy Research: Part 3, Atmospheric sciences.** Elderkin, C.E. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 83p. NTIS, PC A05. Order Number DE88000665/JAW.

The goals of atmospheric research at Pacific Northwest Laboratory (PNL) are to describe and predict the nature and fate of atmospheric contaminants and to develop an understanding of the atmospheric processes contributing to their distribution on local, regional, and continental scales. In 1986, atmospheric research examined the transport and diffusion of atmospheric contaminants in areas of complex terrain and participated in a large, multilaboratory program to assess the precipitation scavenging processes important to the transformation and wet deposition of chemicals composing "acid rain." In addition, during 1986, a special opportunity for measuring the transport and removal of radioactivity occurred after the Chernobyl reactor accident in April 1986. Separate abstracts were prepared for individual projects.

1739 **(UCRL—96242) Potential nucleation scavenging of smoke particles over large fires: A parametric study.** Edwards, L.L.; Penner, J.E. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 11p. (CONF-8708132—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014354/JAW.

From 19. general assembly International Union of Geodesy and Geophysics; Vancouver, Canada (9 Aug 1987).

During hypothesized nuclear exchanges massive fires may be ignited and inject large amounts of smoke into the atmosphere. Considerable evidence has been accumulated to suggest that nucleation scavenging where smoke particles serve as cloud condensation nuclei (CCN) may be an important mechanism for incorporating these particles into cloud water. The fraction of smoke particles that act as CCN depends on the cloud environment as well as the affinity of the smoke particles to water. A numerical model of the detailed microphysics of condensation growth on aerosol and cloud drop distributions is employed to produce a parametric study of the dependence of nucleation to a range of conditions. We consider aerosol number concentrations of $10^9/m^3$ to $10^{12}/m^3$, updraft speeds from 1 to 100 m/s and aerosol particles from fully water soluble to insoluble but wettable. The study provides insight into how well we must characterize smoke particles in order to predict the fraction that act as CCN given the dynamical environment.

1740 **Airborne scientists begin Ohio acid rain study.** *Journal of the Air Pollution Control Association;* **37**: No. 8, 964-966(Aug 1987).

Atmospheric scientists spent June flying through storm clouds over Ohio to collect rain and air samples to better understand rain chemistry, the conditions that cause acid rain and methods for controlling it. The authors will be collecting samples in the Columbus, Ohio area because many of the materials suspected of causing acid rain, such as sulfur dioxide, nitrogen oxides and hydrogen peroxide, can be found in this vicinity. The study is part of the US Department of the Energy's Processing of Emissions by Clouds and Precipitation program (PRECP).

1741 **Rising CO_2 and climate change.** MacCracken, M.C. (Lawrence Livermore National Lab., CA). *Plant Physiology, Supplement;* **83**: No. 4, 165(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

The atmospheric concentrations of carbon dioxide and several other trace gases have been increasing particularly rapidly over the past several decades. The resulting changes in atmospheric composition trap outgoing terrestrial radiation, thereby warming the climate. Climate models project that the rate of global average warming over the next 100 years will increase from about .05%C/decade to as much as a few tenths of a degree per decade. In mid-latitudes, these changes will lengthen the frost-free periods, but may also lead to drier summer conditions. A rising snow line may reduce water input to reservoirs used to store irrigation water. Continuing increases in sea level may impact coastal marsh lands.

Although significant uncertainties remain, particularly in estimating regional and seasonal patterns of expected changes, the climate of the next century is unlikely to be the same as the climate of the past century.

1742 **Observations of nitric oxide fluxes over grass.** Sisterson, D.L.; Hart, R.L.; Wesely, M.L. (Argonne National Lab., Argonne, IL). pp 502-504 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Measurements of pollution dry deposition by micrometeorological methods, which usually provide estimates of vertical fluxes at a height several meters above the surface, have been limited for the most part to substances with gas-phase chemical reaction rates much slower than typical time scales of atmospheric turbulent mixing below the height of measurement. The in-air reactions of some chemical species are rapid, however, and cannot be ignored in micrometeorological flux measurements where the intent is to obtain an estimate of flux at the surface rather than several meters above. For this study, eddy-correlation measurements of NO vertical flux were made periodically from October 1983 to June 1984 above a field of mixed grasses at Argonne's dry deposition measurement site in northeastern Illinois. The measurement location is in a remote section of the Argonne grounds and fairly well isolated from local traffic, but there are few point sources located southwest of the site that frequently affect otherwise low background pollutant concentrations. Data collected during winds from the direction of these points sources are not used in this analysis. The fast-response NO sensor used for eddy correlation in this study utilizes optical detection of chemiluminscent reaction with ozone.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 347, 395, 789, 790, 1624, 1738, 1777, 1778, 1785, 1789, 1790, 1791, 1959

1743 **(CEA-IPSN—2-Rev.3) Accident of Chernobyl.** (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Oct 1986. 154p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87752701/JAW.

RBMK reactors (reactor control, protection systems, containment) and the nuclear power plant of Chernobyl are first presented. The scenario of the accident is given with a detailed chronology. The actions and consequences on the site are reviewed. This report then give the results of the source term estimation (fission product release, core inventory, trajectories, meteorological data...), the radioactivity measurements obtained in France. Health consequences for the French population are evoked. The medical consequences for the population who have received a high level of doses are reviewed.

1744 **(CNEA-AC—29/83) Extreme meteorological conditions.** Altinger de Schwarzkopf, M.L. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Proteccion Radiologica y Seguridad; Ministerio de Salud Publica y Medio Ambiente, Buenos Aires (Argentina). Direccion Nacional de Saneamiento; Buenos Aires Univ. (Argentina). Facultad de Ingenieria). 1983. 56p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01 . Order Number DE87703674/JAW.

Post graduate course in radiological protection and nuclear safety.

Different meteorological variables which may reach significant extreme values, such as the windspeed and, in particular, its occurrence through tornadoes and hurricanes that necesarily incide and wich must be taken into account at the time of nuclear power plants' installation, are analyzed. For this kind of study, it is necesary to determine the basic phenomenum of design. Two criteria are applied to define the basic values of design for extreme meteorological variables. The first one determines the expected extreme value: it is obtained from analyzing the recurence of the phenomenum in a convened period of time, wich may be generally of 50 years. The second one determines the extreme value of low probability, taking into account the nuclear power plant's operating life - f.ex. 25 years- and considering, during said lapse, the occurrence probabilities of extreme meteorological phenomena. The values may be determined either by the deterministic method, which is based on the acknowledgement of the fundamental physical characteristics of the phenomena or by the probabilistic method, that aims to the analysis of historical statistical data. Brief comments are made on the subject in relation to the Argentine Republic area. (R.J.S.).

1745 **(CONF-871101—54) Generation of graphitic soots by an urban fire storm.** Fields, D.E.; Cole, L.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014062/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

We have obtained samples of aerosols deposited during the Hiroshima fire storm that was initiated by the atomic bomb detonated on August 6, 1945, from streaks of "black rain" found on a plaster wall. The artifact appears to contain aerosol particles that may be representative of the aerosols that may lead to a "nuclear winter" (Turco 1983). Gamma spectroscopy measurements indicate the presence of naturally-occurring radionuclides K-40, Ra-226, Ra-228, Th-232, and Th-234, along with the fission product, Cs-137. Sooty particles of varying sizes have been detected using optical photomicrography and examined using x-ray induced x-ray fluorescence. The elements Ca, Sr, Ba, Fe, and Zn, have been detected, and exhibit elemental composition ratios representative of Hiroshima soil. Particle composition and size studies indicate that the particle sizes have a mean diameter of 1.8 microns, and that 30% are less than 1 micron in mean diameter.

1746 **(KFK—4131) Studies on tritium transport in the environment.** Koenig, L.A.; Fark, S.; Hempelmann, S.; Langguth, K.G.; Pagliosa, G.; Papadopoulos, D.; Strack, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). May 1987. 58p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753289/JAW.

It has been possible under the research project to deepen understanding of the radioecological behaviour of tritium. The load per unit area by tritium in precipitations can be described by the same model for rain and snow. The 'specific activity model' does not cover the development versus time of the tritium concentration in plants. On the other hand, median values of air, soil and plant moistures can be well compared with each other. The tritium fraction in organically bound hydrogen undergoes variations with time at a much lower rate than in tissue water. A quick exchange of tritium takes place between the tissue water of fish and the ambient water. The order of magnitude of tritium concentration in the combustion water of the organic substance corresponds to the three months averages of tritium concentration in the main canal. In the vicinity of the tritium exposed main canal tritium can be detected in the groundwater too.

1747 **(KFKI—1987-24/K) Gamma-spectrometric examination of hot particles emitted during the Chernobyl accident.** Balashazy, I.; Szabadine-Szende, G.; Loerinc, M.; Zombori, P. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). May 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700128/JAW.

Ge(Li) gamma-spectrometric examination of hot particles prepared from air filtered dust of Budapest air after the Chernobyl accident is presented. The method of separating hot particles is described and their concentration in the air is determined. The radioactive isotope composition of hot particles is discussed and compared with that of dust samples. Finally, the inhalation probability and radiation burden of hot particles are evaluated. 10 refs.; 4 tables.

1748 (NIRS-RSD—74) Radioactivity survey data in Japan, No. 74, September 1985. (National Inst. of Radiological Sciences, Chiba (Japan)). 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750320/JAW.

This report presents survey data on radioactivity in environmental and dietary materials in Japan. Environmental materials collected include rain and dry fallout (monthly); airborne dust (quarterly); service water (source water and tap water collected semiyearly) and freshwater (yearly, fishing season); soil (yearly); and sea water (yearly) and sea sediments (yearly). Dietary material samples include total diet (semiyearly, June, November or December); rice (yearly, harvesting season); milk [quarterly (February, May, August and November) at producing districts for WHO program, simiyearly (February and August) at producing districts for domestic program, semiyearly (February and August) at consuming districts, and powdered milk collected semiyearly (April and October)]; vegetables [yearly (harvesting season) at producing and consuming districts]; tea (yearly, the first harvesting season); and fish, shellfish and seaweeds (yearly, fishing season). After being collected, these samples are pretreated and prepared to provide solutions for analysis. Strontium-90 and cesium-137 are separated from the solutions. Analysis of calcium is performed by titration with potassium permanganate. Stable strontium and potassium are determined by atomic absorption and flame emission spectrometry, respectively. After the radiochemical separation, the mounted precipitates are counted for activity using low background beta counters normally for 60 min. (Nogami, K.).

1749 (PB—87-215877/XAB) EERF (Eastern Environmental Radiation Facility) standard operating procedures for radon-222 measurement using charcoal canisters. Final report. Gray, D.J.; Windham, S.T. (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility). Jun 1987. 36p. (EPA—520/1-87/005). NTIS, PC A03/MF A01.

This report describes in detail EPA's office of Radiation Programs Eastern Environmental Radiation Facility's standard operating procedures for radon-222 measurement using charcoal canisters. It lists the materials and equipment that are used and explains their laboratory and survey methods.

1750 (PB—87-216149/XAB) Environmental Radiation Data: Report 47, July-September 1986. Final report. (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility). Jun 1987. 55p. (EPA—520/5-87/006). NTIS, PC A04/MF A01.

See also report dated Sep 1985, PB—86-166311.

This report is compiled and distributed quarterly by the Office of Radiation Programs' Eastern Environmental Radiation Facility (EERF), Montgomery, Alabama, and contains data from the Enviromental Radiation Ambient Monitoring System (ERAMS). Data from similar networks operated by contributing States, Canada, Mexico, and the Pan American Health Organization are reported in the ERD when available.

1751 (SAAS—344) Final conference on scientific-technological cooperation in the field of radiation protection between the MoH and the SAAS from 1981 to 1985. Part 4. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1986. vp. (CONF-8509389—Pt.4). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87780163/JAW.

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

Scientific information is presented on the radiation protection of the environment and human populations due to radiation doses from: building materials; operation of nuclear power plants; radioactive waste disposal; and industrial radiography devices. Six individual papers are indexed separately.

1752 (SCPRI-RM—11-1986) Monthly results of measurements, November 1986. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Dec 1986. 59p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87752699/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, underground water, sewage water, drinking water, food chain (milk, vegetables, fishes), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

1753 (VROM-DSB—86-16) Activity measurements in a group of twenty houses in Bernisse (Netherlands) and in an experimental room. Hogeweg, B. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Feb 1986. 39p. (In Dutch). (VROM—60199/3-86). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703775/JAW.

Twenty dwellings are selected on the base of construction features and building materials used, for radiation dosimetry. The concentration of radon and daughterproducts in these dwellings is determined by a large number of factors. To study the relation between concentration and activity of the materials a number of measurements have been carried out with low-level as well as high-level radioactive materials. Also a series of measurements have been carried out in a test room under conditional circumstances. (Auth.). Includes English summary; 9 figs.; 14 tabs.

1754 (VROM-DSB—86-22) Ventilation- and infiltration measurements in a dwelling in view of the problems with radon. Gids, W.F. de; Phaff, J.C. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Jun 1986. 87p. (In Dutch). (VROM—60522/6-86). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703777/JAW.

This report describes the results of continuous ventilation measurements, with N/sub 2/O as tracer gas, of infiltration streams in seven spaces in a dwelling. The results are compared with ventilation model calculations; good agreement was obtained. (Auth.). 24 figs.; 1 table.

1755 Measurement of radionuclides in the environment via Cherenkov radiation. Ross, H.H. (Oak Ridge National Lab., Oak Ridge, TN). pp 339-341 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—). Contract AC05-84OR21400.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The author has developed an alternate approach to the measurement of some beta-emitting nuclides that utilizes the luminescence generated by the Cherenkov process. The luminescence, now known as Cherenkov radiation, was shown to be generated when a charged particle passes through a transparent medium at a speed that exceeds the phase velocity of light in the same medium. Cherenkov emission is different from most other luminescence processes in that it is a purely physical phenomenon. One consequence of this is that Cherenkov systems are free of chemical quenching effects. Conventional methods of analysis for environmental levels of beta-emitting radionuclides are often tedious, time-consuming, and expensive. The Cherenkov method is fast, requires very little operator attention, and is much less expensive to perform.

1756 Random force theory applied to regional scale tropospheric diffusion. Barr, Sumner; Gifford, F.A. (Los Alamos National Lab., NM, USA). *Atmospheric Environment;* **21**: No. 8, 1737-1741(1987).

Twelve examples of long-duration (1- to 50-h) diffusing clouds and plumes, culled from archived data on early nuclear rocket and Plowshare experiments and satellite-observed volcano

plumes, are compared individually with a 'random-force' theory of long-range atmospheric diffusion. The resulting fitted curves yield sets of 12 estimates of each of the dynamical parameters of the theory, the Langrangian integral time-scale of atmospheric turbulence, tsub(L), and the large-scale atmospheric eddy-diffusivity, KAPPA, and of other quantities that can be formed from these, such as the lateral turbulent velocity, upsilonsup(-21/2), the turbulence intensity, i, and the average atmospheric eddy-energy dissipation rate, epsilon. The Lagrangian time-scale values are all within a factor of about two of the value 10^4s, confirming the suggestion that tsub(L) equals the reciprocal of the geostrophic frequency. Stratospheric values of KAPPA and epsilon are an order of magnitude greater than those observed within the troposphere. Values of other quantities are more scattered but yield, in each instance, reasonable averages.

5004 Thermal Effluents Monitoring And Transport

1757 **(PNL-SA—14979) A thermal energy budget for nocturnal drainage flow in a simple valley.** Horst, T.W.; Allwine, K.J.; Whiteman, C.D. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 6p. (CONF-870864—11). NTIS, PC A02. Order Number DE88000103/JAW.

From 4. American Meteorological Society's conference on mountain meteorology; Seattle, WA, USA (25 Aug 1987).

In September 1984 the US Department of Energy Atmospheric Studies in Complex Terrain (ASCOT) program made extensive measurements of the nocturnal wind and temperature fields in the Brush Creek valley of western Colorado. These data are being used to directly evaluate the nocturnal thermal energy budget of this simple valley, with the purpose of examining the relative importance of the various mechanisms that generate and maintain the valley inversion and thus also the nocturnal drainage flow. This paper presents a preliminary description of this analysis. Measurements included an array of nine tethered balloons and four Doppler sodars deployed within the main valley to measure vertical profiles of wind, temperature, and moisture; a Doppler lidar to measure the along-valley wind component throughout much of the valley; several laser anemometers to measure path-averaged valley, tributary, and slope winds; and several surface sites to measure surface fluxes of heat, moisture, and momentum and near-surface profiles of wind and temperature. Meteorological data was also collected at higher elevations with periodic releases of sondes from the valley CSU site and rawinsondes at the corners of a 70-km square centered on Brush Creek. 11 refs., 4 figs.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 1745, 1795

5006 Regulations

REFER ALSO TO CITATION(S) 227, 228, 949, 1121

1758 **(NP—8750424) Outline of US legislation on vehicle exhaust, as of 1984.** Baddar, N.; Geyer, J. (Technische Univ., Graz (Austria). Inst. fuer Verbrennungskraftmaschinen und Thermodynamik). 1986. 153p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750424/JAW.

The valid laws, limiting values and regulations on vehicle emissions are presented as well as methods of measurement and test cycles. (orig./HSCH).

1759 **(PB—87-216404/XAB) Economic-impact study of proposed IPCB (Illinois Pollution Control Board). Regulation Sections 215.204 and 215.207. Final report.** Hemphill, R.C.; Walbert, M.S.; Chambers, W.C.; South, D.W. (Center for Regulatory Studies, Normal, IL (USA)). Jun 1987. 83p. NTIS, PC A05/MF A01.

The economic impact study assesses the costs and benefits associated with amendments to the existing Illinois air laws, Part 215, Sections 215.204 and 215.207 as proposed by the Illinois Environmental Protection Agency. In Docket R82-14, the Agency proposed an amendment to 215.204 that would exclude all exempt solvents (i.e., those compounds exempt from the definition of a volatile organic material (VOM) from the calculation of VOM content for specific coating applications. In 215.207, the proposed amendments will base emissions calculations on the weight of VOM per volume of solids rather than volume of coating.

1760 **(PB—87-216412/XAB) Economic impact of the rotogravure and flexographic printing provisions of proposed regulation R85-21. Final report.** Morrison, R.I.; Romaine, A.G.; Tolley, G.S. (RCF, Inc., Chicago, IL (USA)). Jun 1987. 130p. NTIS, PC A07/MF A01.

The study estimates the economic impact of the proposed Illinois Pollution Control Board regulations controlling the emissions of volatile organic material designated Section 215.345(a), and 215.345(b) which represent amendments to Section 215.401 and 215.402 of the Illinois Administrative Code. Emission controls would be required of all printing establishments employing flexographic and rotogravure printing presses with emissions greater than 100 tons per year. Available emission-control options are carbon absorbers, incinerators, and solvent inks. The total costs to all affected Illinois facilities to employ-emission control technologies are estimated to be between $538,000 and $5,965,000. The concentration of ozone in the atmosphere which is influenced by emissions of volatile organic material, is estimated to fall 0.256% in Chicago and 0.223% in East St. Louis as a result of the proposed regulation. The anticipated ozone reductions will result in human health improvements, increased crop yield, and reduced materials damage.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 421, 1767, 1997

1761 **(CONF-8504316—1) Landscape ecology: Spatial data and analytical approaches.** Krummel, J.R. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE87009672/JAW.

From Workshop on remote sensing; Athens, GA, USA (22 Apr 1985).

The study of landscape structure and function involves the use of data, analysis methodologies, models, and computer resources that have only recently become available to the scientific community. Central to these developments is the idea that landscape studies must explicitly incorporate the spatial pattern found in the environment. While the analysis of spatial patterns in ecology has been an ongoing area of research, the complexity of natural boundaries continues to hinder the incorporation of landscape pattern in ecology. However, the development of remote sensing, digital data processing, geographic information systems, spatially-distributed parameter models, and techniques for quantifying landscape pattern provide new opportunities to analyze natural systems over large geographic areas. This paper briefly outlines some of these developments in the context of the methods and tools needed to explicitly incorporate scale and spatial pattern in the analysis of natural systems.

1762 **(DOE/ER/60492—3) Regulation of decomposition in Alaska tundra and related root mycorrihizal processes in tundra soils: Progress report.** Linkins, A.E. (Clarkson Univ., Potsdam, NY (USA). Dept. of Biology). Sep 1987. Contract FG02-86ER60492. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000399/JAW.

We have found that freeze thaw events which occur in water tracks in the fall, if sufficient water is on the soil surface, can cause rapid decreases in the soil ph. Associated with this change to a negative redox state in the soil is a concomitant increase in extracellular soil enzyme activity (we have measured only cellulases, phosphomonoesterase and protease activities). Enzyme activities

can increase during at least three to four freeze-thaw (redox shifts) until there is no continued significant increase in activity. Therefore, maximum increases in enzyme activities during a fall season of freeze thaw events is estimated to be 4 to 10 fold. The number of freeze thaw events rather than the duration of any one event seems to be the principal factor determining the total increase in enzyme activity. Increases in enzyme activities can be seen in both field samples and soil samples manipulated in the laboratory.

1763 **Comments on use of the terms base cation and base saturation should be discouraged.** Harrison, R.B.; Johnson, D.W. (Oak Ridge National Lab., TN). *Soil Science Society of America Journal;* **51**: No. 4, 1090-1091(Jul-Aug 1987). Contract AC05-84OR21400.

This letter discusses the suitability of using the terms base cation and base saturation in describing soil chemistry. The reactions of K^+, Ca^{+2}, Mg^{+2} and Na^+ in aqueous soil solutions are analyzed, as well as the contrasting effects of aluminum and its ions on such solutions. These in vitro reactions are then related to the chemistry of cations in soils subjected to leaching. The broad problem of semantics in describing soil pH is also addressed.

1764 **Movement of radiotracer metal cations through a forest soil column.** Southworth, G.R. (Oak Ridge National Lab., TN). *Environment International;* **13**: No. 2, 197-201(1987). Contract AC05-84OR21400.

The migration of tritiated water, ^{22}Na, ^{85}Sr, and ^{65}Zn through an intact soil column characterized by high hydrodynamic dispersion was observed under ponded flow conditions. The elution of the tracers is described, using advection-dispersion and two-region/two-site one-dimensional transport models. The advection-dispersion model fit the elution curve of tritiated water well, but the two-region/two-site model was required to describe the elution of the ^{22}Na tracer from the soil column. The ^{85}Sr and ^{65}Zn were retained by the soil column and did not appear in the effluent, despite high hydrodynamic dispersion, which resulted in the nearly immediate appearance of tritiated water in the effluent.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 82, 102, 1332, 1697, 1704, 1705, 1742, 1801, 1805, 1985

1765 **(ORNL/TM—10368) Ecological research needs at hazardous waste disposal sites.** Auerbach, S.I. (ed.). (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000037/JAW.

The Superfund Amendments and Reauthorization Act of 1986 includes sections calling for new efforts in ecological research specifically related to assessing threats to ecosystems from exposures to hazardous wastes. This report describes some new and developing areas of ecological research applicable to the assessment of hazards associated with chemically contaminated sites, to various cleanup approaches and their potential consequences, and to biological monitoring programs established for surveillance after remedial actions have been taken. The application of biological markers (biochemical indicators) offers a promising method for monitoring and predicting the long-term effects of contaminants at the population level. Research is needed to develop a quantitative relationship between the chemical contaminants and changes in the suites of biological markers. There is a need to determine the impact of wastes on the naturally occurring microbial flora and the potential for in situ biodegradation as well. Research is needed to develop improved exposure models for both aquatic and terrestrial ecosystems that can be used in routine assessments. Dealing with the potentially disruptive effects of toxic substances on ecosystems requires a knowledge of the flows of energy and matter and of the related ecological food web. The prediction of possible disruptive effects on a whole food web requires a detailed knowledge of the structure of the web and of the many dynamic feedback effects in the total ecosystem.

1766 **(PB—87-212890/XAB) Protecting the environment at Superfund sites through chemistry.** Sanning, D.E.; Black, M.I. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Jul 1987. 17p. (EPA—600/D-87/222). NTIS, PC A02/MF A01.

This paper presents an overview of the research activities conducted by the U.S. EPA Remedial Action Program during the period of 1984 through September 1987. Special emphasis is placed on in-situ and on-site technologies that utilize chemical techniques to minimize the migration of contaminants from uncontrolled hazardous-waste sites. Subjects discussed include: delivery and recovery technologies; chemical treatment of metals; chemical treatment of organics and inorganics; and immobilization by chemical means.

1767 **(PNL—6100-Pt.2) Pacific Northwest Laboratory: Annual report for 1986 to the DOE Office of Energy Research: Part 2, Environmental sciences.** (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000664/JAW.

This report summarizes progress in environmental sciences research conducted by Pacific Northwest Laboratory (PNL) for the Office of Health and Environmental Research in FY 1986. The program is focused on terrestrial, subsurface, and coastal marine systems, and this research forms the basis, in conjunction with remote sensing, for definition and quantification of processes leading to impacts at the global level. This report is organized into sections devoted to Detection and Management of Change in Terrestrial Systems, Biogeochemical Phenomena, Subsurface Microbiology and Transport, Marine Sciences, and Theoretical (Quantitative) Ecology. Separate abstracts have been prepared for individual projects.

1768 **(PNL-SA—14239) Economic effects of reduced forest growth on the United States' forest economy and on Canadian-US lumber trade.** Callaway, J.M.; Darwin, R.F.; Nesse, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 18p. (CONF-8612108—1). NTIS, PC A02. Order Number DE88000081/JAW.

From Technology transfer conference; Ontario, Canada (9 Dec 1986).

Reductions in tree growth rates may be related to increases in acid deposition and other man-made air pollutants over the last three decades. We review the evidence regarding reductions in forest growth and, using economic theory, show how physical changes can impact the production and purchasing decisions of buyers and sellers in timber and primary wood product markets. We then show how standard willingness-to-pay principles can be used to place monetary values on the physical damages caused by air pollution. In the second part of the study, we describe how information about changes in tree growth can be used in conjunction with existing inventory projection and timber market models to simulate the potential economic effects of acid deposition/air pollution in the United States. Two sets of simulations are conducted. The final part of the study presents the results of the simulations, quantifying the potential economic effects of acid deposition in the United States and to a limited extent, Canada. Estimates of the effects of reduced tree growth on the welfare of timber owners and the buyers and sellers of lumber and plywood in the United States are presented, along with information about changes in the welfare of lumber producers in Canada. Results suggest that if increases in Canadian stumpage fees (as a government response to transboundary pollution damage) are not too great, Canadian lumber producers and exporters may actually earn higher profits because of increased demand from the United States for Canadian lumber exports. 16 refs., 3 figs., 6 tabs.

1769 **Chemical equilibria of selenium in soils: a theoretical development.** Elrashidi, M.A.; Adriano, D.C.; Workman, S.M.; Lindsay, W.L. (Savannah River Ecology Lab., Aiken, SC). *Soil Science;* **144**: No. 2, 141-152(Aug 1987). Contract AC09-76SR00819.

Thermodynamic data were used to develop equilibrium reactions and constants for 83 selenium (Se) minerals and solution spe-

cies that relate to soils. The solubilities of the metal-selenate minerals are very high in well-aerated soils and are not expected to persist in these systems. The solubilities of 17 metal-selenite minerals studied suggest that $MnSeO_3$ (c) is the only selenite mineral that might persist in strongly acid soils. Other selenite minerals appear to be too soluble to form in soils particularly in the alkaline pH range. Metal-selenide minerals, in general, are extremely insoluble in soils under highly reducing conditions. Formation of these metal-selenides may prevent the precipitation of elemental Se in soils. The redox (pe+pH) of soils controls Se speciation in solution. None of the 27 metal solution complexes studied was found to contribute significantly to total soluble Se in normal cultivated soils. Except for $MnSeO_3$ (c), none of the other known selenite or selenate minerals is expected to persist in soils. In moderately to highly oxidized conditions it is possible that an adsorption mechanism may control the distribution of Se between solid surfaces and the solution phase. However, at low redox, either elemental Se or a metal-selenide mineral, e.g., Cu_2Se(c), PbSe(c) may control Se solubility in soils.

1770 **Soil pH and extractable sulfate-sulfur distribution as influenced by tree species and distance from the stem.** Wolfe, M.H.; Kelly, J.M.; Wolt, J.D. (Oak Ridge National Lab., TN). *Soil Science Society of America Journal;* **51**: No. 4, 1042-1046(Jul-Aug 1987). Contract AI05-83OR21363.

Stemflow influence on the distribution of soil (NaH_2PO_4 extractable) SO_4-S and pH was evaluated as a function of tree size class and distance from the stem for red maple (Acer rubrum L.) and scarlet oak (Quercus coccinea Muenchh.) at two locations in Tennessee which have received different historical inputs of S from atmospheric sources. Soil profiles around the base of each study tree were sampled by horizon at 25, 50, 100, and 200 cm from the stem along four transects radiating from the stem at 90° angles. Distance from the stem influenced soil pH of A horizons at 25 cm from the stem of red maple and scarlet oak at both sites. Species had an effect on Bt2 and Bt3 soil SO_4-S concentrations. The Bt2 (0.49 cmol kg^{-1}) and Bt3 (0.67 cmol kg^{-1}) horizons beneath scarlet oaks had greater SO_4-S concentrations than corresponding horizons beneath red maple (0.29 and 0.43 cmol kg^{-1}, respectively). The results of this study indicate that increased sampling intensity combined with tracer studies will be need to clearly determine the effect of stemflow, tree species, and tree size on subtlety-manifested soil properties such as pH and SO_4-S as well as other elements of interest.

1771 **Lead in vegetation, forest floor, and soils of the Great Smoky Mountains National Park.** Bogle, M.A.; Turner, R.R.; Baes, C.F. III. (Oak Ridge National Lab., TN). *Environment International;* **13**: No. 3, 235-246(1987). Contract AC05-84OR21400.

The scarcity of lead toxicity data for forest plant species and the increasing concern over the possible role of metals in the decline of forests in western Europe and the Eastern US necessitate that lead and other metals be closely monitored in these important forest ecosystems. Samples of vegetation, forest floor material, and soil were collected at five spruce-fir sites and two hardwood sites in the Great Smoky Mountains National Park (GSMNP). Mean forest floor lead concentrations were lower than average values reported in an earlier EPA study of lead levels in the GSMNP, and lower than recently published values for similar sites in the northeastern US and western Europe. As expected, lead concentrations increased (1) with increasing age of coniferous foliage, (2) with increasing site elevation for foliage and forest floor material, and (3) with increasing degree of decomposition of forest floor material. 40 references, 2 figures, 7 tables.

1772 **Steady state terrestrial ecosystems and the global carbon cycle.** Lugo, A.E.; Brown, S. (Dept. of Agriculture, Forest Service, Rio Piedras, Puerto Rico). *Vegetatio;* **68**: 83-90(1986). Contract AC05-84OR21400.

The assumption that landscapes dominated by mature vegetation are presently in carbon steady state with the atmosphere is challenged. Evidence suggests that the vegetation and soils of these landscapes are frequently disturbed and over short time periods (<300 yr) slowly sequester atmospheric carbon. The critical consideration in this argument is the time interval used to evaluate a steady state. Current models of carbon flux through the terrestrial biota limit their considerations to 120 yr, a short and inadequate time interval for realistic assumptions about steady state in the carbon cycle of vegetation.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 292, 293, 294, 295, 297, 298, 302, 303, 304, 308, 335, 336, 338, 339, 340, 352, 356, 357, 359, 360, 361, 362, 363, 365, 370, 371, 372, 373, 374, 386, 387, 388, 392, 788, 1428, 1612, 1743, 1746, 1748, 1750, 1752, 1754, 1755, 1829

1773 **(ARL/TR—075) Plutonium-contaminated fragments at the Taranaki site at Maralinga.** Burns, P.A.; Cooper, M.B.; Duggleby, J.C.; Mika, J.F.; Williams, G.A. (Australian Radiation Lab., Melbourne). Jul 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700102/JAW.

A detailed assessment is presented of the distribution of plutonium-contaminated fragments and sub-millimetre particles in the vicinity of the Taranaki site at the former U.K. Atomic Weapons Test Range at Maralinga in South Australia. The area which is contaminated with fragments has been divided into three general regions with the designations 'heavily contaminated', 'moderately contaminated' and 'plumes'. The average surface density, activity and estimated total number of fragments are presented for each region. Average surface densities of all fragments with americium-241 activities greater than 2 kBq are estimated to be 33, 7 and 2 m/ sup -2/ for the 'heavily contaminated', 'moderately contaminated' and 'plumes' regions respectively. The total number of such fragments is estimated to be in excess of three million which accounts for a total plutonium activity of approximately 0.8 TBq. The implications of these results for a rehabilitation program are discussed.

1774 (INIS-mf—11002, pp 40-51) **Issues of radionuclide migration in the ground.** Tsappe, D.; Pechel', M. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A stationary and non-stationary models are presented for the underground waters motion. Computer codes have been developed for determining the radioactive element spreading through the ground in one-dimensional approximation. The sensitivity of calculation results to some parameters has been evaluated. 3 figs.

1775 (INIS-mf—11002, pp 52-56) **On Kr-85 concentration measuring in the atmosphere.** Butkus, D.V.; Styro, B.I.; Zemkayus, K.K. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A simple and reliable method has been developed for measuring Kr-85 concentration in the atmosphere. Two measuring equipment sets (a stationary and movable one) were made. The equipment set includes gas-refrigerator ZIF-1002, an installation for kripton extraction and a radiometric instrument for determining Kr-85 concentration. 5 refs.; 3 figs.

1776 (INIS-mf—11002, pp 64-70) **Geophysical issues related to Kr-85 in the atmosphere and new tasks for research.** Styro, B.I.; Butkus, D.V. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Kr-85 sources and their contributions to its content in the atmosphere are described. Measuring results obtained in a number of countries within 30 years are presented. The radiation impact has been shown not to exceed 1% from the maximum permissible concentration. Nevertheless further growth of Kr-85 concentration can lead to substantial changes in the ionization state of the atmosphere (the electric resistance reduction, the vertical ion current rise and so on) which would result in negative consequences for the biosphere on Earth. 7 refs.; 2 figs.

1777 (INIS-mf—11002, pp 71-75) **On Kr-85 interaction with solid and liquid atmospheric aerosols and ground surface.** Butkus, D.V.; Styro, B.I.; Zemkayus, K.K. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Experiments show a rise of Kr-85 sticking to aerosole with the increase of the environment radioactivity. Measuring results for Kr-85 absorption by various plants (birch, oak, maple, alder, nuttrees, poplar, mountain ash, fir, pine and oth.) are given. Experiments are described wherein the rate of Kr-85 washing-out from the atmosphere with water phase transitions has been evaluated. A schematic design of an installation for the investigation of Kr-85 absorption in plants is presented. 7 refs.; 1 tab.; 2 figs.

1778 **(INPE—3780) Measurements of atmospheric and gamma rays-balloon experiments at subantarctic region.** Jayanthi, U.B.; Correa, R.V.; Blanco, F.G. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jan 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703581/JAW.

The results of two stratospheric balloon experiments conducted to measure the atmospheric X and gamma rays are presented. These experiments, conducted at Comandante Ferraz base in subantarctic region, have provided the spectrum of ground radioactivity in gamma rays (0.2 to 2.9 MeV) and atmospheric X-ray spectra at different altitudes. We specifically chose to discuss the observed ceiling spectrum of X-rays in the 28 to 180 KeV region observed at 7.0 g. cm/sup -2/. We have utilized the data of other experiments with different telescope geometries, to evaluate the builup effects due to cosmic ray secondaries in atmosphere. This behaviour, previoulsy studied for atmospheric gamma rays, permitted to compare the up/down flux rations to explain the observed atmospheric X-ray spectrum.

1779 **(NAGRA-NTB—81-10) Stripa Project. Migration in a single fracture. Preliminary experiments in Stripa.** Abelin, H.; Neretnieks, I. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Apr 1981. 34p. Nagra, CH-5401 Baden, Switzerland.

A method of tracer injection and of water collection to be used in the main investigation of 'Migration in a single fissure' has been tested and found to function well. With this injection equipment it is possible to introduce tracers into the fissure as a step or a pulse. The injection can be done either under natural pressure or with over pressure. The collection of water sampled can be done under anoxic atmosphere. Injection of Rhodamine-WT and Na-Fluorescein with over pressure has been performed. It has been found that Rhodamine-WT is influenced in some way along the flow path. Rhodamine-WT thus cannot be used to characterize the water residence time without a knowledge of the interaction mechanisms. Based on the experiences from this investigation the equipment and operation will be somewhat modified for use in the main investigation.

1780 **(NAGRA-NTB—81-14) Data base for a site specific migration analysis of radioactive elements from a final repository.** Hadermann, J. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1981. 33p. (In German). Nagra, CH-5401 Baden, Switzerland.

Migration analysis is of considerable importance in long-term safety analysis of radioactive waste repositories. In a first step our plans are to calculate transport of radionuclides using data - as far as possible - for an undisturbed hydrogeology. Thereby a reference case is defined. In a later step, possible events and processes can be considered leading to a deviation from the reference case. The present work gives the data base for a selected part of a comprehensive geosphere transport calculation. We restrict ourselves to a critical evaluation of parameters pertinent to the migration analysis of the /sup 245/Cm chain. This includes the important nuclide /sup 237/Np. For the first time we are able to perform a site specific calculation for repositories planned in deep geologic formations in Switzerland. The well known fact that the data basis is extremely sparse is pointed out once more and concretized in detail.

1781 (NAGRA-NTB—86-26, pp 26-29) **Influence of hydraulic effective disturbed zones on geosphere transport and individual doses.** Hadermann, J.; Herzog, F. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Sep 1986. (In German). Nagra, CH-5401 Baden, Switzerland.

In Some thoughts concerning the extent of crystalline host rock for a final repository for radioactive wastes in Northern Switzerland.

Based on the hydraulic calculations of the preceding contribution, geosphere transport and dose calculations were performed for selected nuclides which may be released from a waste repository. The resulting doses lie within the range defined by groundwater scenarios investigated to date, with nuclide transport in the fractured dykes of the middle Crystalline.

1782 **(NIRS-R—12) Report of radioactivity investigation and research in fiscal year 1985.** (National Inst. of Radiological Sciences, Chiba (Japan)). Oct 1986. 125p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750070/JAW.

The National Institute of Radiological Sciences has continued the investigation and research since fiscal year 1959 on the environmental radioactivity level due to the radioactive fallout accompanying nuclear explosion experiment and the radioactive substance released from nuclear facilities, and the analysis of the safety of those, as a part of the investigation and research of radioactivity of Science and Technology Agency. At present, accompanying the remarkable progress of the peaceful utilization of atomic energy, the concern of the nation about environmental radioactivity has heightened, and the importance of the investigation and research of radioactivity as the base of the effect on environment and people increases. In such situation, in fiscal year 1985, the budget of 132.9 million yen was appropriated, and the investigation of radioactivity level and dose in environment, food and human body, the investigation of level around nuclear facilities, the business of radioactivity data center, the fundamental investigation concerning the evaluation of the results of radioactivity investigation, the training of environmental radiation monitoring technicians and the investigation and research on the emergency measurement of radiation exposure and the countermeasures were carried out. These results are reported. (Kako, I.).

1783 **(NIRS-RSD—72) Radioactivity survey data in Japan.** (National Inst. of Radiological Sciences, Chiba (Japan); Japan Chemical Analysis Center, Chiba). Mar 1985. vp. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87780131/JAW.

Results are reported of radiation monitoring of cesium 137 and strontium 90 in foods and environmental materials in Japan. Data from surveys of soils, rainwater, service water, freshwater, foods, air and dry fallout are included in six separate articles.

1784 **(NIRS-RSD—73) Radioactivity survey data in Japan.** (National Inst. of Radiological Sciences, Chiba (Japan); Japan Chemical Analysis Center, Chiba). Jun 1985. vp. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87780116/JAW.

Separate abstracts were prepared for papers published as a collection of radioactivity survey data for Japan.

1785 **(NIRS-RSD—76) Radioactivity survey data in Japan, No. 76, March 1986.** (National Inst. of Radiological Sciences, Chiba (Japan)). 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750319/JAW.

This report presents survey data on radioactivity in environmental and dietary materials in Japan. Environmental materials collected include rain and dry fallout (monthly); airborne dust (quarterly); service water (source water and tap water collected semiyearly) and freshwater (yearly, fishing season); soil (yearly); and sea water (yearly) and sea sediments (yearly). Dietary material samples include total diet; rice (yearly, harvesting season); milk [quarterly (February, May, August and November) at producing districts for WHO program, simiyearly (February and August) at producing districts for domestic program, semiyearly (February and August)

at consuming districts, and powdered milk collected semiyearly (April and October)]; vegetables [yearly (harvesting season) at producing and consuming districts]; tea (yearly, the first harvesting season); and fish, shellfish and seaweeds (yearly, fishing season). After being collected, these samples are pretreated and prepared to provide solutions for analysis. Strontium-90 and cesium-137 are separated from the solutions. Analysis of calcium is performed by titration with potassium permanganate. Stable strontium and potassium are determined by atomic absorption and flame emission spectrometry, respectively. After the radiochemical separation, the mounted precipitates are counted for activity using low background beta counters normally for 60 to 90 min. (Nogami, K.).

1786 **(NVO—272) The dynamics of transuranics and other radionuclides in natural environments, December 1985.** Howard, W.A.; Fuller, R.G. (eds.). (USDOE Nevada Operations Office, Las Vegas). Sep 1987. 585p. (CONF-830610—). NTIS, PC A25/MF A01; 1; GPO Dep. Order Number DE87014456/JAW.

From Plutonium information conference of the Nevada Applied Ecology Group; Las Vegas, NV, USA (28 Jun 1983).

The papers contained in these proceedings provide an update of the various transuranics studies conducted at the Nevada Test Site. Separate abstracts have been prepared for the separate papers. (ACR)

1787 **(SLU-REK—62) Aftermath of Chernobyl in Sweden: Levels of /sup 137/Cs in foodstuffs.** Mascanzoni, D. (Swedish Univ. of Agricultural Sciences, Uppsala. Dept. of Radioecology). 1986. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753220/JAW.

The insertion and subsequent accumulation of radioactive substances in ecosystem focuses attention on a highly complex set of natural processes. In a health perspective, it poses particular concern for the food chain. In order to issue action guidelines and to reduce the doses from intake of contaminated food, an extensive program of measurements was started. The primary aim of the monitoring was to obtain a detailed survey of contents of radionuclides in a wide variety of foodstuffs, including vegetables, fruits, edible wild plants, dairy products, wild and tame animals. The results presented in this report cover the period May-November 1986 and concern only the food samples collected in order to be able to issue recommendations to the public in the most contaminated areas.

1788 **(VROM-DSB—86-13) Natural radioactivity of soils in the Netherlands.** Bannink, D.W.; Keen, A.; Koester, H.W.; Pennders, R.M.J.; Winkel, J.H. de. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands)). Feb 1986. 38p. (In Dutch). (VROM—60196/3-86). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703772/JAW.

Forty percent of the natural radiation exposure of man is caused by the primordial radionuclides - U-238, Th-232 and K-40 - and their daughters in the soil. It is shown that the activity concentrations of these nuclides vary between Dutch soils and that they lie within the normal range reported by the UNSCEAR committee. In linear regression models a clear link was found between the activity concentrations and the following soil properties: grain size distribution, organic matter and lime content, whether or not in combination with soil type. The same models are capable to predict the activity concentrations in various soils with reasonable precision. No improvement of the models was obtained by incorporating the pH and/or sampling depth. Possible further investigations to refine the models are suggested. (Auth.). 13 refs.; 2 figs.; 17 tabs.

1789 **(VROM-DSB—86-14) Radon concentration in the Netherlands.** Meijer, R.J. de; Put, L.W.; Veldhuizen, A. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands)). Feb 1986. 116p. (In Dutch). (VROM—60197/3-86). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703773/JAW.

In 1000 dwellings, which can be assumed to be an reasonable representation of the average Dutch dwellings, time averaged radon concentrations, radon daughter concentrations and gamma-exposure tempi are determined during a year with passive dosemeters. They are also determined outdoor at circa 200 measure points. (Auth.). Includes English summary; 58 refs.; 32 figs.; 24 tabs.

1790 **(VROM-DSB—86-19) Model for the calculation of the radiation dose from natural radionuclides in the Netherlands.** Ackers, J.G. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Feb 1986. 87p. (In Dutch). (VROM—60201/3-86). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703776/JAW.

A model has been developed to calculate the radiation dose incurred from natural radioactivity indoors and outdoors, expressed in effective dose equivalence/year. The model is applied on a three rooms dwelling characterized by interconnecting air flows and on a dwelling with crawlspace. In this model the distinct parameters are variable in order to allow the investigation of the relative influence. The calculated effective dose equivalent for an adult in the dwelling was calculated to be about 1.7 mSv/year, composed of 15% from cosmic radiation, 35% from terrestrial radioactivity, 20% from radioactivity in the body and 30% from natural radionuclides in building materials. The calculations show an enhancement of about a factor of two in radon concentration in air in a room which is ventilated by air from an adjacent room. It is also shown that the attachment rate of radon products to aerosols and the plate-out effect are relatively important parameters influencing the magnitude of the dose rate. (Auth.). 37 refs.; 12 figs.; 42 tabs.

1791 **(VROM-DSB—86-23) Final report and evaluation of the SAWORA research program on background radiation levels from natural origin in the Netherlands.** Hogeweg, B. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Sep 1986. 66p. (In Dutch). (VROM—60793/8-86). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703778/JAW.

In order to study the various factors which determine the dose resulting from background radiation, in particular for the indoor situation, the SAMORA-programme was initiated in 1982. The various aspects studied were: 1) a determination of the current background radiation level, for the indoor as well as the outdoor situation; 2) an inventory of the radioactivity of the building materials; 3) the radioecological aspects from fly-ash and gypsum deposits; 4) a risk estimation of lung tumour induction at low doses and for low dose rates; 5) technical factors determining the effective dose equivalent. In this report the connection of the results derived in the different studies will be discussed. From the study on radioconcentration it became clear that the indoor concentration is strongly determined by the concentration in the crawl space. On the basis of the results of the programme an estimation of the lung tumour risk for the Dutch population is presented. For the current levels it is calculated that the risk is approximately 2.1 lung tumours per 100,000 persons. Since in 1982 the mean lung tumour death rate for the Dutch population was 56.8 per 100,000, this result demonstrates that the calculated contribution is relatively low (4%). Furthermore it is calculated that the maximum increase of this contribution as a result of the introduction of active gypsum building materials will be of the order of 1%. (Auth.). Contains a list of SAWORA-publications (34 refs.); 51 refs.; 4 figs.; 6 tabs.

1792 **Characteristics of radionuclide-contaminated soils from the Sedan crater area at the Nevada test site.** Lee, S.Y.; Tamura, T.; Larsen, I.L.; Essington, E.H. (Oak Ridge National Lab., TN). *Soil Science;* **144**: No. 2, 113-121(Aug 1987). Contract AC05-84OR21400.

The distribution of radionuclides in selected soil profiles and the characteristics of contaminated ejecta in the Sedan crater area (site of a nuclear excavation test conducted in 19862) were investigated in an attempt to define the physicochemical parameters controlling the redistribution of radionuclides required to assess the environmental and health hazards of the contaminated area. The results showed that concentrations of /sup 239,240/Pu, ^{241}Am, ^{155}Eu, ^{137}Cs, /sup 102m/Rh, ^{90}Sr, and ^{60}Co decreased with depth and with increasing distance from ground zero. The contaminated particles occurred as moderately porous calcium aluminosilicate glass, predominantly and size (2-0.1 mm in diameter), in the loamy sand

or sandy loam soil. Differences in distribution patterns and concentration ratios among the radionuclides indicted a that a significant fraction of the ^{137}Cs and ^{90}Sr present in contaminated overburden materials had moved downward during the past 22 years, under arid environmental conditions, into the buried soil.

1793 **Strontium-90 in food and bone from fallout.** Klusek, C.S. (Dept. of Energy, New York, NY). *Journal of Environmental Quality;* 16: No. 3, 195-199(Jul-Sep 1987).

The long-term, continuing study of fallout ^{90}Sr in humans and the environment has provided basic information that is required to assess human exposure from ^{90}Sr from nuclear tests. The current stratospheric inventory of ^{90}Sr is very low and the rate of new input into the environment is exceeded by the rate of decay. However, because of its long physical and biological half-life, ^{90}Sr continues to be one of the most persistent artificial radionuclides that reaches humans through ingestion. Quarterly sampling of 19 representative food items in New York and San Francisco since 1954 provides a record of the changes that occur in the relative contributions of ^{90}Sr by the various food categories, as well as the changes in the total ^{90}Sr intake to the diet in these typical Northern Hemisphere regions. The current intake of 0.18 Bq/d in New York has declined from maximum levels of 1.1 Bq/d in 1963 to 1964. The ^{90}Sr content of San Francisco diets has been consistently lower than the New York level. The retention of dietary intake has been studied through the analysis of bone samples from long-term residents of the same cities. The measured concentration of ^{90}Sr in adult bones in the USA is now 50% less than the peak concentrations of 85 Bq/kg Ca seen in 1965.

5104 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 292, 352

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 104, 105, 107, 436, 1837

1794 (ANL/CNSV-TM—173, pp 155-164) **Siting a waste-to-energy facility: the first acceptance test.** Buhler, F. (CSI Resource Systems, Inc., Boston, MA). May 1987. NTIS, PC A11/MF A01. Order Number DE87014258/JAW. (CONF-8606334—).

From Workshop on energy from municipal waste: opportunities for the Southwest; Austin, TX, USA (23 Jun 1986).

The purpose of this presentation is to review briefly the technical and environmental requirements for site selection and address the facility siting process itself, including strategies that can move the site selection task along in a manner that avoids the expensive delays and defeats that kill projects. In addition to the technical/environmental criteria summarized various energy market siting considerations are presented which should be addressed in the preliminary facility site assessment.

1795 **(DOE/EH—0053-Vol.4) The environmental survey manual: Appendices E, F, G, H, I, J, and K.** (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC. Office of Environmental Audit). Aug 1987. 512p. NTIS, PC A22/MF A01; 1; GPO Dep. Order Number DE88000215/JAW.

Appendices E, F, G, H, I, J and K of the Environmental Survey Manual address the following topics: Field Sampling Protocols and Guidance; Guidelines for Preparation of Quality Assurance Plans; Decontamination Guidance; Data Management and Analysis; Sample and Document Management; Health and Safety Guidance for Sampling and Analysis Teams; Documents for Sampling and Analysis Program. (ACR)

1796 **(DOE/NV/10322—26) Selected stratigraphic contacts for drill holes in LANL use areas of Yucca Flat, NTS [Nevada Test Site].** Drellack, S.L. Jr.; Cavazos, A.P. (Fenix and Scisson, Inc., Mercury, NV (USA)). Jul 1987. Contract AC08-84NV10322. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87014104/JAW.

This report is a compilation of selected stratigraphic contacts in drill holes of Yucca Flat, Nevada Test Site (NTS), used by the Los Alamos National Laboratory (LANL). This is the product of an ongoing effort to establish and maintain the most up-to-date database of formation tops in LANL use areas of Yucca Flat. Several changes have been made to the 1986 edition of the data base report. First, the year the drill hole was completed (Year Comp) has been added to the report in order to help determine the confidence level of the data. Advances in drilling techniques have improved the quality and accuracy of drill cuttings. 12 refs., 3 figs., 2 tabs.

1797 **(ORNL/ESH—1/V25) Resource management plan for the Oak Ridge Reservation: Volume 25, Resource Management Organization data base and bibliography.** Jones, K.A. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88000644/JAW.

A reference collection was developed by the Information Support Unit of the Information Resources Organization for the Resource Management Organization. The Reference Collection contains print copies of documents dealing with environmental aspects of the Oak Ridge Reservation from 1942 to the present. Subjects in this collection include environmental monitoring, hydrology, wildlife management, geology, environmental assessment, and area studies. Currently included in this collection are documents from Oak Ridge National Laboratory, the Oak Ridge Gaseous Diffusion Plant, the Oak Ridge Y-12 Plant, and the Department of Energy Oak Ridge Operations Office, as well as from external sources such as the Tennessee Valley Authority, the Public Health Service, and the US Geological Survey. Unclassified, unlimited-distribution technical reports, journal articles, and monographs written over the past 45 years are included. It will expand to include additional and new documents. A data base containing a bibliographic citation and an abstract (when available) for each document in the collection has also been constructed at the request of the Resource Management Committee to support research activities in environmentally related subject areas pertaining to the Oak Ridge Reservation. They are available to Martin Marietta Energy Systems' staff and their subcontractors. This bibliography lists entries alphabetically, grouped by date of publication. Technical reports, journal articles, conference proceedings, and monographs are cumulated in sections dated 1940 to 1959, 1960 to 1969, 1970 to 1974, 1975 to 1979, 1980 to 1984, and 1985 to present.

1798 **Landscape ecology.** Urban, D.L.; O'Neill, R.V.; Shugart, H.H. Jr. *BioScience;* 37: No. 2, 119-126(Feb 1987). Contract AC05-84OR21400.

In this paper the authors outline an approach to landscape study that employs a hierarchical paradigm of pattern and behavior. Although emphasis is on forested landscapes, we can generalize a theory of landscape ecology. Attention is focused on the wide range of phenomena in a natural terrestrial landscape by considering the apparent complexity of landscape dynamics and illustrating how a hierarchical paradigm lends itself to simplifying such complexity. This perspective also affords insights into the management of man-dominated landscapes.

1799 **Beyond the not-in-my-backyard impasse.** Peelle, E.; Ellis, R. Oak Ridge, TN; Oar Ridge National Laboratory (1987). 14p.

Key assumptions of past planning in hazardous waste siting are no longer valid. Workable, legitimate solutions to hazardous waste siting will require (1) a comprehensive integrated hazardous waste management strategy giving primary emphasis to waste stream reduction, detoxification, and recycling; (2) extensive interactive communication and participation among citizens, regulators, and waste managers during planning, siting, and operation; and (3) net institutional arrangements and guarantees that instill confidence among citizens about the need for and safety of proposed hazardous waste facilities.

5106 Regulations

REFER ALSO TO CITATION(S) 106

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 1318, 1839, 1997

1800 **(AD-A—182967/0/XAB) Arctic drifting buoy data 1979 - 1985. Final report.** St, J.W. (Coast Guard Research and Development Center, Groton, CT (USA)). Apr 1987. 126p. (CGR/DC—07/87). NTIS, PC A07/MF A01.

As part of an investigation into the fate of potential Arctic oil spills, the U.S. Coast Guard Research and Development and Canadian Marine Drilling, Ltd. (CANMAR) released satellite-tracked drifting buoys at two sites in the southern Beaufort Sea during six years (1979-1983, 1985). The sites were near Canadian offshore-drilling locations off the Tuktoyaktuk Peninsula, Northwest Territories and near Prudhoe Bay, Alaska. An analysis of the trajectories of these buoys indicated that the majority of buoy drift was in an alongshore (east/west) direction. When buoys did move in a north/south direction, their speeds were generally lower and the length of excursions shorter. A comparison of the drift of these buoys to the calculated geostrophic wind (east/west component only) revealed that, over a long term, the buoys drifted, on average, with the mean wind. Buoys had average drift speeds which varied from 1% to 5.5% of the mean wind. When cumulative drift was compared to the cumulative wind, high correlations were noted for those buoys with spar type hulls. This indicates that the cumulative large-scale geostrophic wind plays an important role in the cumulative movement of the upper 1-2 meter of the water column. A comparison of the trajectories of buoys which were released in close spatial and time proximity was conducted. In general, their drifts were variable enough to indicate that the total forcing function on separate buoys was different.

1801 **(KFK—4281) Studies of the desorption kinetics of lead from clay minerals by nitrilotriacetat (NTA).** Spallek, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie). Aug 1987. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750426/JAW.

The kinetic behavior of Pb-desorption by nitrilotriacetic acid (NTA) from some clay minerals was studied. In the kaolinite suspension the desorption equilibrium is reached already after a few minutes. In the montmorillonite and illite suspensions, however, the rapid initial desorption is followed by a Pb-readsorption by these clays lasting from hours to days. Therefore the Pb-concentration in the solution decreases to about 25% of the initial maximum concentration. An influence of pH, NTA- or Pb-NTA-adsorption effects could be excluded being responsible for the readsorption effect. The thesis of two thermodynamical and kinetical significantly different adsorption positions was confirmed by kinetic, X-ray and electrophoretic measurements. A theoretical simulation with two different adsorption reactions and complex equilibria is possible. The oscillation of the Pb-concentration in the solution - observed in special cases - is well explained by a model, supported by colloid-chemical experiments (turbidity, particle size, sedimentation characteristics).

1802 **(NAGRA-NTB—82-09) Exploratory borehole Boettstein. Working programme.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Sep 1982. 103p. (In German). Nagra, CH-5401 Baden, Switzerland.

An extensive geophysical borehole logging programme will serve to verify the results of the core analysis and complement the core data. Numerous borehole logs are to be registered with different types of tools. These allow one to determine various parameters essential for the full description of the rock sequences penetrated. A first category of logs enables the petrographical identification of the different rock types and indicates porous zones that are either water- or hydrocarbon-bearing. A second category provides data e.g. on the degree of pore and fracture fill, rock density and rock temperature, natural gamma radiation and rock-mechanical properties. Other logs measure strike and dip of the sedimentary layers and the position of rock fractures. A fourth category provides information on the diameter and the deviation of the borehole, the quality of casing cementations and the position of casing joints. In addition, well shooting surveys will supply exact values of seismic velocities for the various rock units; data that are needed for the depth correction of the reflection profiles from Nagra's regional seismic network. With numerous hydrological tests ranging from an open-hole production test of the Muschelkalk aquifer to labelled slug tests in low-permeability crystalline sections, the hydraulic conditions of deep groundwater flow will be investigated. The recovered water samples will undergo full physical and geochemical analysis. Furthermore, their isotope content is to be measured in order to estimate the age of the various formation waters. To round off the scientific investigations, a series of rock-mechanical and geotechnical laboratory tests will provide characteristic values to be applied eventually in the design and construction of shafts and caverns for an underground repository.

1803 **Why do turtles live so long.** Gibbons, J.W. (Savannah River Ecology Lab., Aiken, SC). *BioScience;* **37**: No. 4, 262-268(Apr 1987). Contract AC09-76SR00819.

Turtles appear to live longer than most other species of vertebrates, according to both maximal lifespans from zoo records and survivorship patterns in natural populations. Turtle longevity may reflect low metabolic activity, an absence of physiological and anatomical senility, a large investment in the adult's protective shell, and a life history with a long maturation period.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 82, 222, 368, 951, 956, 1046, 1704, 1725, 1766, 1767, 1815, 1985

1804 **(BMFT-FB-T—86-245) Relevance of micro- and blue-green algae to the degradation of xenobiotics in a model system simulating surface waters. Final report.** Steber, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Henkel K.G.a.A., Duesseldorf (Germany, F.R.). Hauptabteilung Oekologie). Dec 1986. 39p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753251/JAW.

For the purpose of a more realistic assessment of the degradability of chemicals in surface waters it was investigated whether microalgae and blue-green algae contribute significantly to the degradation in corresponding model tests. The ultimate degradation of 22 /sup 14/C-labelled xenobiotics was studied in a shake flask test by comparing conventional test conditions (bacterial inoculum, incubation in the dark) with those in the presence of an artificial biocenosis of bacteria and algae (light/dark incubation). With regard to total biodegradation (/sup 14/CO/sub 2/ + /sup 14/C-biomass), mainly comparable results were obtained. Only pentachlorophenol and aminotrismethylene- and ethylenediamine tetramethylene phosphonic acids showed an increased degradation in light-exposed and bacteria/algae-inoculated assays. More detailed investigations indicated a microalgae-independent photodegradation of PCP; moreover, algae seem to be involved only indirectly in the extensive degradation of the two phosphonic acids. It was concluded that microalgae and blue-green algae, in most cases, do not significantly contribute to the degradation potency of a surface water model system. Thus, routine degradation tests employing a bacteria/microalgae-biocenosis are not considered worthwhile. With 27 refs., 5 tabs., 4 figs.

1805 **(LA—11106-MS) Kinetics experiments and bench-scale system: Background, design, and preliminary experiments.** Rofer, C.K. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract AC05-84OR21400;W-7405-ENG-36. 34p. (DOE/HWP—42). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000818/JAW.

The project, Supercritical Water Oxidation of Hazardous Chemical Waste, is a Hazardous Waste Remedial Actions Program (HAZWRAP) Research and Development task being carried out by the Los Alamos National Laboratory. Its objective is to obtain information for use in understanding the basic technology and for scaling up and applying oxidation in supercritical water as a viable process for treating a variety of DOE-DP waste streams. This report gives the background and rationale for kinetics experiments on oxidation in supercritical water being carried out as a part of this HAZWRAP Research and Development task. It discusses supercritical fluid properties and their relevance to applying this process to the destruction of hazardous wastes. An overview is given of the small emerging industry based on applications of supercritical water oxidation. Factors that could lead to additional applications are listed. Modeling studies are described as a basis for the experimental design. The report describes plug flow reactor and batch reactor systems, and presents preliminary results. 28 refs., 4 figs., 5 tabs.

1806 **(LBL—23497) Summary of hydrologic and hydrochemical models with potential application to deep underground injection performance.** Mangold, D.C.; Tsang, C.F. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000650/JAW.

The report presents summaries of codes useful for investigating contaminant transport associated with underground injection disposal, produced mainly from secondary references that summarize and evaluate these codes. The 57 codes that have been selected are arranged into three broad classes which correspond to their general area of application: geochemical models, solute transport models for both saturated and unsaturated media, and hydrochemical models that combine the chemical and transport models.

1807 **(NP—7770313) Stochastic models for the simulation of the transport of non-cohesive sediments in open beds.** Faerber, K. (Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Wasserwesen). 1987. 125p. (In German). NTIS (US Sales Only), PC A06. Order Number DE87770313/JAW.

The most comprehensive part of this research work considers the dispersion process of sediment particles in turbulent flow. At first the relatively simple tubulence model introduced by Lee and Shen was applied. A simplified BBO-equation for single particles serves as a simulation model for settling velocity in turbulent flow considering the acceleration force and nonlinearity of friction. As a result one gets the drag coefficient of spheres in relation to the turbulence intensity and density of the grain material. By this we can derive a rising drag coefficient by growing values for both parameters.

1808 **(ORNL/TM—10527) Application of XAD-4 solid sorbent to the collection of pesticides from water samples: Final report, November 1985-November 1986.** Maskarinec, M.P.; Manning, D.L. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001515/JAW.

This report summarizes work done to evaluate the efficiency of XAD-4 resin for removing pesticides from water for subsequent analysis. A limited number of pesticides, including lindane, aldrin, and 4,4'-DDT, were added to water, extracted by elution on XAD-4, and analyzed by gas chromatography with electron capture detection. The method was found to be reasonably effective, at least for semiquantitative purposes.

1809 **(PB—87-213880/XAB) Processes, coefficients, and models for simulating toxic organics and heavy metals in surface waters.** Schnoor, J.L.; Sato, C.; McKechnie, D.; Sahoo, D. (Iowa Univ., Iowa City (USA). Dept. of Civil and Environmental Engineering). Jun 1987. 318p. NTIS, PC A14/MF A01.

The reference manual provides kinetics formulations for users of models that compute the fate of toxic organic chemicals and heavy metals in natural surface waters. Rates and coefficients provided in the manual were collected through literature reviews through 1986. The manual describes basic concepts of transport and transformation mechanisms. Development of generalized mathematical models and analytical solutions to the equations are demonstrated. The manual includes a brief general description of four models (EXAMS, TOXIWASP, HSPF, and MINTEQ), example runs, and comparisons of these models.

1810 **(PB—87-216503/XAB) Biosorption/heavy-metal ions from industrial/mining waste waters. Technical completion report.** Darnall, D.W. (New Mexico State Univ., Las Cruces (USA). New Mexico Water Resources Research Inst.). Sep 1986. 41p. (WRRI—210). NTIS, PC A03/MF A01.

Supersedes PB—86-222676.

This report discusses interactions between algal biomass and various metal ions. It was found that for most of the ions examined uptake is dependent upon pH, with cations bound most strongly above pH 4 and complex anions bound most strongly at lower pH values. Heat treatment of the biomass was found to have little effect on binding capacity. As with other ion-exchange matrices, the extent of metal-ion removal is strongly influenced by the solution composition -- in particular, the presence of competing ligands. Algal biomass can be readily immobilized in silica to produce a durable chromatographic support which shows substantial longevity in lab-scale operations.

1811 **(PB—87-217204/XAB) Operational, spatial, and environmental water planning and analysis. Technical completion report.** Bartholic, J.F.; Kittleson, K.M.; Bill, B. (Michigan State Univ., East Lansing (USA). Center for Remote Sensing). Mar 1987. 28p. NTIS, PC A03/MF A01.

Several models simulating the movement of nutrients, chemicals, and particulates through surface and ground water were reviewed. One model, the Agricultural Nonpoint Source Pollution Model (AGNPS), was modified to run on an AT&T 3B2 and an IBM-AT computer. User-friendly prompts were incorporated and the model was applied in Branch County, Michigan.

1812 **(UCID—19774-Vol.6) The feasibility of using fiber optics for monitoring groundwater contaminants: VI, Mechanistic evaluation of the Fujiwara reaction for detection of organic chlorides: Quarterly technical report, February 1, 1987-April 30, 1987.** Angel, S.M.; Daley, P.F.; Langry, K.C.; Albert, R.; Kulp, T.J.; Camins, I. (Lawrence Livermore National Lab., CA (USA)). 18 Jun 1987. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000016/JAW.

Considerable effort has been directed toward the development of fluorescence based fiber optic sensors capable of detecting organochlorides of toxicological interest in groundwater. The chemistry adapted for use in the organochloride sensor is ostensibly well established and has been applied clinically for colorimetric detection and quantitative measurement of various polyhalogenated compounds. However, as noted in earlier reports, in the process of transferring this clinically oriented system into one designed for remote groundwater analysis, several aspects of the probe chemistry proved to be especially troublesome. Therefore, to overcome deficiencies related to the sensor chemistry and to allow for a well founded basis for optimizing the performance of the probe, a review of the chemistry employed for detecting the organochlorides was undertaken. The chemistry related to the detection of chloroform and trichloroethylene is examined. A detailed anlaysis of the chemistry of haloforms in the presence of nucleophiles and strong base is presented. In view of considerable literature support, a revised reaction sequence for the Fujiwara reaction is developed. This new perspective on the reaction of chloroform and trichloroethylene with pyridine is related to experiments recently performed at Livermore, the results of which not only permit a greater understanding of the Fujiwara reaction, but also allow defined new approaches for the selective measurement of trichloroethylene an chloroform. 38 refs., 8 figs., 6 tabs.

1813 **Synthetic polymers for accumulating organic compounds from water.** Junk, G.A. (Ames Lab., Iowa State Univ., Ames, IA). pp 201-246 of Organic pollutants in water: Sampling, analysis and toxicity testing. Suffet, I.H.; Malaiyandi, M. Washington, DC; American Chemical Society (1987). (CONF-840805—). Contract W-7405-ENG-82.

From 188. meeting of the American Chemical Society; Philadelphia, PA, USA (26 Aug 1984).

The increased use of solid synthetic polymers and the advantages of this procedure compared to other approaches for determining organic components present in water are described in this review. The procedure involves sorption of the organic components present in water onto a polymer by using simple column chromatography and subsequent removal of the sorbed components by elution with an appropriate solvent. Various polymers used for the sorption and different solvents used for elution are reviewed. The main polymers are styrene-divinyl-benzenes (XAD-1, XAD-2, XAD-4, Porapaks, Chromosorbs), methacrylates (XAD-7, XAD-8), diphenyl-p-phenylene oxide (Tenax), polytetrafluoroethylenes (Teflon), polyurethanes, polypropylene, bonded phases, and ion-exchange resins; the primary eluents are methanol, ethyl ether, and acetone. These solvents and polymers are discussed relative to their characteristics and applications and the theoretical aspects of the methodology.

1814 **Concentration techniques for isolating organic constituents in environmental water samples.** Jolley, R.L.; Suffet, I.H. (Oak Ridge National Lab., Oak Ridge, TN). pp 3-14 of Organic pollutants in water: Sampling, analysis and toxicity testing. Suffet, I.H.; Malaiyandi, M. Washington, DC; American Chemical Society (1987). (CONF-840805—). Contract AC05-84OR21400.

From 188. meeting of the American Chemical Society; Philadelphia, PA, USA (26 Aug 1984).

Solutions must be concentrated or the constituents must be isolated before trace amounts of the various organics present as complex mixtures in environmental water samples can be chemically analyzed or tested for toxicity. A major objective is to concentrate or isolate the constituents with minimum-chemical alteration to optimize the generation of useful information. Factors to be considered in selecting a concentration technique include the nature of the constituents (e.g., volatile, nonvolatile), volume of the sample, and analytical or test system to be used. The principle methods currently in use involve (1) concentration processes to remove water from the samples (e.g., lyophilization, vacuum distillation, and passage through a membrane) and (2) isolation processes to separate the chemicals from the water (e.g., solvent extraction and resin adsorption). Selected methods are reviewed and evaluated.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 293, 295, 298, 302, 344, 345, 355, 368, 371, 385, 392, 792, 1397, 1746, 1748, 1750, 1752, 1755, 1784, 1785, 1806

1815 **(IAEA-RL—143) Inorganic constituents in lake sediment (IAEA/SL-3). An IAEA intercomparison study.** La-Brecque, J.J.; Hanna, A.N.; Abdel-Rassoul, A.A.; Schelenz, R. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories). Jul 1987. 99p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88700111/JAW.

This report presents results of the interlaboratory comparison on the determination of 33 trace elements in a lake sediment sample. The results were reported from 45 laboratories in 28 countries. The evaluation was based on 656 laboratory means from 3413 individual determinations. All of the class A (high confidence) recommended values for As, Ce, Eu, Hb, K, La, Nd, Rb, Sm, Sr, and Th are assigned 95% confidence interval with the exception of arsenic. The class B (lower confidence) recommended values are considered for Al, Br, Ca, Cs, Dy, Lu, Mg, Na, Sb, Sc, Ta, Tb, Ti, U, and Yb. The analytical techniques of atomic absorption, atomic emission, fluorimetry, laser fluorescence, neutron activation, voltametry and x-ray fluorescence were used. Figs and tabs.

1816 **(INIS-mf—10716) Radioactivity values in the river Elbe. A report on the results of the measuring programme dealing mainly with the radioactivity of the waters of the Elbe, the sediments of the river, and braces from the river as biological indicators - from Schnackenburg to the North Sea, 1978-1983.** (Arbeitsgemeinschaft fuer die Reinhaltung der Elbe der Laender Hamburg, Niedersachsen und Schleswig-Holstein, Hamburg (Germany, F.R.); Niedersaechsisches Landesamt fuer Wasserwirtschaft, Hildesheim (Germany, F.R.); Wasserguetestelle Elbe, Hamburg (Germany, F.R.)). [1987]. 230p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE87753294/JAW.

The largest portion of artificially produced radionuclides that currently gets into the river Elbe still stems from the fallout of supra-terrestrial atom bomb tests carried through decades ago in part. On the basis of a longitudinal profile of the Elbe from Schnackenburg to the Elbe estuary, no measurable increases were ascertained in the course of the systematic investigations pointing to artificial radionuclides of regional origin. This is also true of the nuclear power plants situated on the river Elbe. The amounts of radioactive nuclides, accurately known from emission measurements, which are discharged with sewage water from the Stade and Brunsbuettel nuclear power plants and reach the Elbe are so slight that they result in no measurable increase in radioactive nuclide levels in the Elbe. This is confirmed by the theoretical calculation.

1817 (INIS-mf—11002, pp 44-47) **Indicator concentration detection technique for man-made radionuclides in natural water pools.** Bochkov, L.P.; Vakulovskij, S.M.; Lishevskaya, M.O.; Nikitin, A.I.; Tertyshnik, Eh.G. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A concentration method is described for radionuclides present in NPP cooling water pools. Both concentrations of neutron activation (chronium-51, ceasium-134, cobalt-58 et al.) and fission products (ceasium-137, cerium-141 et al.) are determined. High sensitivity is ensured by means of large volume sample processing (from hundreds up to thousands liters), the sampling and radionuclide concentration being carried out simultaneously. To determine the radionuclide content in the concentrated samples gamma- and beta-spectrometry is applied, the major part of gamma-sources being registered with the use of large volume Ge(Li) detectors. Data on minimal detectable radionuclides content in fresh and saline waters are given. 4 refs.; 1 tab.; 1 fig.

1818 (INIS-mf—11002, pp 76-87) **Hygienic and ecological evaluations of radiation conditions on the Baltic Sea on the basis of the USSR specialists investigations within 1976-1980.** Gusev, D.I.; Gedeonov, L.I.; Ivanova, L.M.; Stepanova, V.D.; Pavlovskij, O.A.; Smirennaya, V.A. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Data are presented on the radioactivity levels of the water, sea ground sedimentations and hydrobionts in the east part of the Baltic Sea (11 stations) as well as in the Kurshskij gulf, gulf of Riga and gulf of Finland (18 stations), that were obtained by the Soviet specialists within 1976-1980. The detailed analysis results for both sea (sprats, plaices, cods) and freshwater (breams, perches, pikes and oth.) fishes are given. The sources of strontium-90 and caesium-137 accumulation in fishes have been revealed, and these radionuclides impact on population evaluated. A draft of a plan for further investigations to be carried out by CMEA member-countries and Finland is presented. 12 refs.; 2 tabs.

1819 (INIS-mf—11002, pp 88-95) **Evaluation of population doses in Poland due to radioactive contamination of the Baltic Sea.** Rosin'ski, Shch.; Gvyazdovski, B.; Kraevski, P. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A model has been developed to describe the radioactivity migration in the sea and its impact on population. Food chains including fish and fish products are taken into consideration as well as the radiation hazards due to external exposure. A simplified radionuclide cycle in the sea ground sedimentations, ground fauna, plankton and sea water is described and radioactivity accumulation in the fish evaluated. Calculation techniques have been suggested both for internal and external exposure. Population doses in Poland due to the Baltic Sea radioactive contamination are analyzed. 5 tabs.; 1 fig.

1820 (INIS-mf—11002, pp 96-113) **Objectives and results of the study of the Baltic Sea and GDR coastal waters radioactive contamination.** Vajs, D.; Kunert, J.; Tile, J. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Methods are described for determining radionuclide (Sr-90 and Cs-137) contents in water, fish and sea ground sedimentations. Measuring results of the radionuclide vertical distribution in the Baltic Sea that were obtained in 1979-1980 are presented. Data are given on the radionuclide content in the food-fish inhabiting both the open sea and the GDR coastal waters. Transport factors for Sr-90 and Cs-137 have been determined in the water/fish system depending on the water/fish system depending on the fish species and fishery location. 2 refs.; 9 tabs.; 3 figs.

1821 (INIS-mf—11002, pp 114-120) **Radionuclide concentration field structure variations in the Baltic Sea water.** Styro, D.B.; Klejza, I.V. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

By means of the objective analysis on the basis of measuring results the radionuclide concentration fields (Cs-137, Sr-90, Ce-144) have been determined in the near surface and 50 m deep waters of the Baltic Sea. The calculated values of normalized autocorrelation functions reveal only a weak correlation between the radionuclide concentration field elements as compared with such data for the Atlantic and Pacific Ocean. The radionuclide concentration field structure has proved to be more uniform during spring and summer time. Though it can considerably vary under the conditions of strong cyclones resulting in appearing of local zones with decreased or increased radionuclide concentration. 6 refs.; 8 figs.

1822 (INIS-mf—11002, pp 121-126) **Cs-137, Sr-90 and Ce-144 concentrations in the Baltic Sea.** Styro, D.B.; Kadzhene, G.I.; Lukinskene, M.V.; Nemanis, A.P. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The surface-depth concentration distributions of man-made radionuclides have been studied in the Baltic Sea and the Skagerrack. The vertical concentration distributions in the Baltic Sea differ as a rule for various radionuclides. Cs-137 concentration can have a maximum at any depth, Sr-90 maximum and minimum concentrations were observed in the near-surface and near-bottom waters respectively. The absolute values of Ce-144 concentration changed rather quickly over the whole sea space. For the coastal zone of the Baltic Sea the clearest tendency has been revealed with the radionuclide concentration decrease from the spring towards the autumn. 5 refs.; 1 tab.; 4 figs.

1823 (INIS-mf—11002, pp 127-136) **Radioactive contamination of the Baltic Sea in 1980.** Vakulovskij, S.M.; Katrich, I.Yu.; Krasnopevtsev, Yu.V.; Nikitin, A.I.; Chumichev, V.B. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The experimental results are discussed that were obtained in March-April 1980 during study of water and ground sedimentation contamination in the Baltic Sea and the Skagerrack. The radiation conditions in the south-west Baltic were shown to be dependent on the water input from the North Sea contaminated by the fuel reprocessing plant wastes from Great Britain. The limits of radioactive contamination spreading have been determined and the amounts of long-living Cs-137, Sr-90 and tritium stored in the Baltic Sea in 1980 evaluated. The obtained results are compared with those based on earlier measurements. The input of Cs-134 and Cs-137 due to water exchange with the North Sea has been evaluated also. 14 refs.; 1 tab.; 4 figs.

1824 (INIS-mf—11002, pp 137-143) **Sr-90 distribution in water, hydrobionts and ground sedimentations of the Baltic Sea.** Dushauskene-Duzh, R.F. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The results of a study of Sr-90 distribution in the Baltic Sea ecological system are presented. Its concentratio n variations in water have been found to be insignificant within the study period. The radionuclide accumulation by the major algae species in the Baltic Sea has been investigated. A dependence of Cr-90 built-up on the hydrobiont mineral composition was established and factors affecting its accumulation in molluscs revealed. Data on Sr-90 distribution in organs and tissues of cod are presented as well as those on Sr-90 accumulation in the sea ground sedimentations and its vertical distribution. 4 refs.; 6 tabs.; 2 figs.

1825 (INIS-mf—11002, pp 144-154) **Hygienic and ecological evaluations of radioactivity of the Soviet part of the Danube on the basis of investigations within 1976-1980.** Gusev, D.I.; Gedeonov, L.I.; Ivanova, L.M.; Pavlovskij, O.A.; Stepanova, V.D.; Borovikova, N.M.; Nagovitsyna, L.I. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Data are presented on the radioactivity levels of water, ground sedimentations and hydrobionts in the Soviet part of the Danube obtained within 1976-1980. The average individual dose equivalents are given for the critical group of population in the riverside region due to radioactivity intakes with the Danube fish. The population doses due to fish eating have been calculated. The available data on the radioactivity of the Soviet part of Danube allow to conclude that there is no impact from the nuclear power industry on this part of the river. 4 refs.; 7 tabs.

1826 (INIS-mf—11002, pp 155-159) **On the possible impact from the nuclear industry on tritium content in the Danube.** Kostadinov, K.; Yanev, Ya. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

An analysis has been carried out of tritium sources in the Danube and the impact of each particular source on the variation of tritium concentration. The evaluations were done on the basis of IAEA data on PWRs and BWRs performance during normal operation. According to the published data by Austrian, Yugoslavian, Rumanian and Bulgarian authors a conclusion can be drawn that the contribution from the nuclear power plants to the tritium content in the Danube at the present time does not exceed 3-4%. Calculations for the year 200g show the expected tritium concentration level to be decreased by factor of 4 while the nuclear industry contribution should grow up to 50%. 8 refs.; 2 tabs.; 2 figs.

1827 (INIS-mf—11002, pp 160-165) **Study of tritium concentration fluctuations in the Hungarian part of the Danube.** Siladi, M. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780027/JAW. (CONF-8205317—Pt.4).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Water samples from the Danube were taken near Budapest, to the north from the city. The measuring technique based on the electrolytic enrichment of the sample by tritium has been used. Dependencies of tritium concentration in the Danube water on the meteorological conditions, season and other factors are presented. The results are in good agreement with IAEA data. A peak of tritium concentration observed in January 1980 is described. The reliability of the obtained data is discussed. 6 refs.; 2 figs.

1828 **(NAGRA-NTB—81-13) Solubility and speciation calculation for uranium, plutonium, neptunium and thorium in natural groundwaters. Theory, thermodynamic data bases and first applications.** Schweingruber, M. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1981. 112p. (In German). Nagra, CH-5401 Baden, Switzerland.

The computer code MINEQL was adapted and extended to assess the solubility and speciation of radioactive waste nuclides in groundwaters under conditions which are expected to exist in the surroundings of planned underground repositories. By means of an additional data base including standard reaction enthalpies and heat capacities at 25 degrees C, the relevant equilibrium constants at 25 degrees C can be converted to other temperatures using Ulich's formulae. The activity coefficients for dissolved species are modelled with a temperature dependent function of the Davies' approximation type. The report is segmented in three main parts: (1) a review of the MINEQL fundamentals and a summary of the theory needed for the extensions; (2) an outline of the general programme structure and of criteria applied to the selection of thermodynamic data; (3) a discussion of the results from first model applications to evaluate the solubility and speciation of U, Pu, Np and Th in two Swiss groundwaters, based either on the approach of negligible chemical disturbance or on a solid/solution titration concept. All thermodynamic data involved in this study are collected in an appendix, together with a compilation of references.

1829 **(NAGRA-NTB--83-22) Biosphere transport of radionuclides. First modelling by using a selected example .** Bundi, A. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 46p. (In German). Nagra, CH-5401 Baden, Switzerland.

The dispersion of radionuclides in the biosphere and their uptake by man via various nutritional pathways is studied using a compartment model. The sample environment is the area of the lower Limmat and Aare valleys. General considerations of the compartmental description of the biosphere are made. The problem of the description of surface features, in particular soil, sediment and water, is studied in detail using the code BIOPATH. This study is intended to be an example of how a model of the biosphere could be constructed. It is shown that this is a reasonable model to calculate the spreading of radionuclides in the biosphere and that it indicates the relative significance of individual compartments, pathways and radionuclides. Calculated values of doses to man, however, should not be used as reference data for safety analyses.

1830 **(NAGRA-NTB—83-27) Geochemical and isotope characterization of the Stripa groundwaters - progress report.** Carlsson, L.; Olsson, T.; Andrews, J.; Fontes, J.C.; Michelot, J.L.; Nordstrom, K. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Feb 1983. 134p. Nagra, CH-5401 Baden, Switzerland.

This progress report contains the recent results of the hydrogeochemical program, a part of the hydrogeological investigations at the Stripa test site. A considerable number of groundwater samples have been collected and analyzed for major dissolved cations, anions, trace elements, stable isotopes, radioisotopes and dissolved gases to depths approaching 900 m. This report presents (1) the background geology and hydrogeology (2) major and trace element characteristics of the deep groundwaters (3) major radioelement characteristics and inert gases (4) stable isotopes of water and dissolved sulfate and (5) preliminary interpretations of the groundwater chemistry trends. As the studies at Stripa are still in progress, all interpretations are considered tentative and preliminary. Any conclusions drawn may be modified as a consequence of continued sampling and analysis.

1831 **(NAGRA-NTB—86-22) Code verification of the groundwater flow model FEM301. HYDROCOIN - Level 1 - case 2 and case 6.** Kimmeier, F.; Wacker, C.; Perrochet, P.; Hufschmied, P.; Kiraly, L. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1986. 235p. Nagra, CH-5401 Baden, Switzerland.

The FEM301 code allows modelling steady-state flow of groundwater circulation in saturated media in 1, 2 or 3 dimensions. FEM301 has been used in the project Gewaehr which summarizes the safety analyses for final disposal of radioactive wastes in Switzerland. In order to check the accuracy of the results of FEM301, Nagra participates in the international HYDROCOIN project which comprises 24 teams from 10 different countries, the aim being to compare the results of different calculation codes. This report describes the work that has been done in this connection with the FEM301 code. Two cases are presented. The first is a two-dimensional model of a fractured rock mass. A quantitative comparison of FEM301 with 2 different models (GWHRT and STOKES) shows good agreement. The second case is a three-dimensional model of a sedimentary basin presenting marked contrasts in the hydraulic conductivities. A qualitative comparison has been carried out with the models SWENT, FE3DGW and CFEST. A detailed quantitative comparison must be published in the frame of the final report of HYDROCOIN - Level 1.

1832 (NAGRA-NTB—86-26, pp 11-17) **Geological characterization of water flow systems in the crystalline bedrock of Northern Switzerland.** Gautschi, A.; Meyer, C.; Peters, T.; Meyer, J.; Hofmann, B. (Geologisches Buero Dr. H. Jaeckli AG, Zurich and Baden, Switzerland; Geotest AG, Zollikofen, Switzerland; Bern Univ., Switzerland). Sep 1986. (In German). Nagra, CH-5401 Baden, Switzerland.

In Some thoughts concerning the extent of crystalline host rock for a final repository for radioactive wastes in Northern Switzerland.

In the Boettstein borehole, various water flow systems in the granite were observed and recorded in detail. The properties of these systems which are relevant from the point of view of safety were modelled with appropriate parameter variations for Project Gewaehr. Investigations in other deep boreholes and field and literature studies from the Black Forest region show that other water flow systems can also be found in the crystalline Basement of northern Switzerland.

1833 (NAGRA-NTB—86-26, pp 18-25) **Effects of deep-reaching disturbed zones on water movements in the geosphere.** Hufschmied, P.; Huerlimann, W. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle, NAGRA, Baden, Switzerland; Motor-Columbus Ingenieurunternehmung A.G., Baden, Switzerland). Sep 1986. (In German). Nagra, CH-5401 Baden, Switzerland.

In Some thoughts concerning the extent of crystalline host rock for a final repository for radioactive wastes in Northern Switzerland.

This article discusses the attempts made using the hydrodynamic models FEM301 and FREESURF to estimate the effect of deep-reaching disturbed zones on groundwater flow in the repository near-field and the progression to the biosphere of flow paths which are important for radionuclide transport.

1834 **(PB—87-212676/XAB) Review of treatment methods for removal of uranium from drinking water.** Sorg, T.J. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Jul 1987. 20p. (EPA—600/D-87/228). NTIS, PC A02/MF A01.

This paper summarizes recent information on the effectiveness of various methods for uranium removal from drinking-water supplies. A variety of methods have been studied and reported upon; however, most of the information was developed from either laboratory or pilot plant studies. Very limited data exists for full-

scale-treatment systems. Treatment methods discussed include conventional coagulation/filtration, lime softening, ion exchange, activated alumina, granular activated carbon, and reverse osmosis.

1835 **(PB—87-217170/XAB) Predicting the occurrence of radon-222 in North Carolina groundwater.** Loomis, D.P.; Watson, J.E.; Crawford-Brown, D.J. (North Carolina Water Resources Research Inst., Raleigh (USA)). May 1987. 66p. (UNC-WRRI—87-230). NTIS, PC A04/MF A01.

The intent was to develop an understanding of some of the factors that effect the concentration of radon-222 (^{222}Rn) in drinking-water supplies of North Carolina. Data for this investigation were collected on a sample of 96 North Carolina public water supply wells. Water samples were collected and analyzed for ^{222}Rn content. Data on well characteristics (discharge, specific capacity, depth, and casing length) were obtained from existing sources. Study results concluded that there is a distinct and statistically significant difference in the mean ^{222}Rn concentrations of samples drawn from any given rock type. The study indicates that the highest ^{222}Rn concentrations are likely to be found in supplies located in granites and gneisses within the Blue Ridge, Inner Piedmont, and Raleigh Belt regions.

1836 **Radionuclides in Nevada test site groundwater: Transport by clay colloids.** Buddemeier, R.W.; Hunt, J.R. (Lawrence Livermore National Lab., Livermore, CA). pp 534 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—). Contract W-7405-ENG-48.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The Chishire (U20n) event was a nuclear detonation fired February 14, 176, at the Nevada Test Site (NTS). It was detonated in a fractured ryholitic lava formation 1167 m below the surface and 537 m below the water table. Yield was in the 200 to 500 kiloton range. A slant-drilled re-entry hole was cased and perforated within the cavity. Cavity water was intermittently pumped and sampled between September 1983 and May 1985. Because a number of strongly sorbing or insoluble radionuclides were observed in the "dissolved" phase (0.45 μm filtered) of early cavity samples, Lawrence Livermore National Laboratory initiated a series of filtration and ultrafiltration experiments using large-volume samples. Filtrates and ultrafiltrates were dried, weighed, gamma counted and further characterized; filters were gamma counted. X-ray diffraction studies of ultrafiltrate and retentate solids showed that the ultrafiltrates were composed of evaporite salts (halite, trona, aragonite), but that the retentates were dominated by quartz and (Ca, K) feldspars.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 1201, 1795, 1797, 1799

1837 **(PNL—6355) Further ecological and shoreline stability reconnaissance surveys of Back Island, Behm Canal, Southeast Alaska.** Young, J.S.; Strand, J.A.; Ecker, R.M. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000667/JAW.

A diver reconnaissance of the intertidal and subtidal zones of Back Island was performed to catalog potentially vulnerable shellfish, other invertebrates, and marine plant resources occurring at three proposed alternate pier sites on the west side of Back Island. Additionally, a limited survey of terrestrial vegetation was conducted in the vicinity of one of the proposed alternate pier sites to describe the littoral community and to list the dominant plant species found there. Finally, a reconnaissance survey of the shoreline of Back Island was conducted to evaluate potential changes in shoreline stability resulting from construction of onshore portions of the Southeast Alaska Acoustic Measurement Facility (SEAFAC).

1838 **(TVA/ONRED/AWR—87/26) Status of important fisheries in Guntersville Reservoir, 1985: Technical report series.** Warden, R.L. Jr.; Brown, A.M. (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development; Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources; Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Services and Field Operations). Apr 1987. 40p. NTIS, PC A03/MF A01. Order Number DE88900016/JAW.

Recently, chambers of commerce in the Guntersville Reservoir area have expressed concern about a decline in the quality of fishing, particularly for largemouth bass. Numerous reports from anglers indicated only small bass were being caught. Area officials felt this would adversely affect tourism. Hence, the issue became an economic one as well as an environmental one. Fishing for crappie and redear sunfish apparently has not declined. Commercial fishing also appears stable with no apparent declines in harvest; however, recent problems with chemical pollutants in Wheeler and Wilson Reservoirs and increases in numbers of commercial fishermen due to industry layoffs could increase harvest rates in Guntersville beyond what the fishery can support. Objectives of the Guntersville Reservoir fisheries evaluation are to: (1) determine the status of the fishery resource as an indicator of the biological health of the reservoir and (2) formulate management recommendations that can be implemented by TVA and/or cooperating agencies. 6 refs., 9 figs., 8 tabs.

1839 **(TVA/ONRED/AWR—87/32) Application of the Index of Biotic Integrity to existing TVA data.** Saylor, C.; Scott, E.M. Jr. (Tennessee Valley Authority, Norris (USA). Office of Natural Resources and Economic Development; Tennessee Valley Authority, Norris (USA). Div. of Air and Water Resources). Sep 1987. 31p. NTIS, PC A03/MF A01. Order Number DE88900013/JAW.

The Index of Biotic Integrity (IBI) is a recently developed method of evaluating environmental quality at a given stream site by measuring certain aspects of the resident fish population (Karr, 1981). Application of IBI in different geographical regions, and to various perturbations of water quality and habitat has been shown by Fausch et al. (1984), Karr et al. (1986), and Leonard and Orth (1986). IBI was used by O'Bara (in press) to assess the effects of coal mine runoff on certain second order streams in the Cumberland River Drainage. IBI continues to undergo testing and modification; however, its value as a monitoring tool is apparent, and it may very well become a standard method for various TVA projects. To evaluate the use of IBI on streams of the Tennessee Valley, this report examines application of the method to existing TVA fish data that were gathered to complete Activity 2 of the Cumberlandian Mussel Conservation Program (CMCP) (TVA, 1986). 9 refs., 1 fig., 8 tabs.

1840 **Benefit-cost analysis of salmon and steelhead mitigation strategies using a formal model.** Scott, M.J.; Englin, J.E.; McWethy, L.G. (Battelle Pacific Northwest Labs., Richland, WA, USA). pp 193-202 of Strategic planning in energy and natural resources. Lev, B. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (North-Holland) (1987). (CONF-8604185—).

From 2. symposium on analytic techniques for energy, natural resources, and environmental planning; Philadelphia, PA, USA (3 Apr 1986).

Production of hydroelectric power in the Pacific Northwest over the last 50 years has been implicated as one of the causes in the major decline of naturally occurring anadromous salmon and steelhead runs in the Columbia River watershed. Under the Pacific Northwest Power Planning and Conservation Act of 1980 (Public Law 96-501, 16 U.S. Code, 839), the Pacific Northwest Power Council is charged with developing a fisheries program to 'protect, mitigate, and enhance' Columbia River anadromous fish stocks. In practice, program implementation must consist of a number of interrelated actions at specific points in the life cycle of the fish, such as spawning bed preservation, removing stream blockages, preserving downstream migrating juveniles by actions such as additional spill at hydroelectric projects, and regulating the catch of adult fish. Battelle, Pacific Northwest Laboratories has developed a FORTRAN-based model called PWRFISH, capable of analyzing

environmental-economic tradeoffs at each point in the salmon life cycle. PWRFISH is fundamentally an accounting model. It accepts fisheries scientists' estimates of salmon and steelhead production and survival rates and combines these data with catch statistics and market and nonmarket economic values, to produce value of catch by species, fishery and area. PWRFISH was used to conduct a benefit-cost analysis of certain preservation actions at a hydroelectric project on the main stem of the Columbia. Model results indicate that some actions being proposed by fishery agencies may result in net economic cost to the region.

5206 Regulations

REFER ALSO TO CITATION(S) 106, 1809, 1971

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 945

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 304, 1681, 1840

5302 Assessment Of Energy Technologies

1841 **(AD-A—182939/9/XAB) Environmental impact statement/environmental impact report for the proposed marathon industrial/commercial business center tract 5167, Hayward California. Supplement. Draft report.** (Earth Metrics, Inc., Burlingame, CA (USA)). Jun 1987. 559p. NTIS, PC A24/MF A01.

Joint State Federal environmental impact document concerning a regulatory permit application by Marathon U.S. Realties, Inc. under Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. The proposed project involves a non-water-oriented industrial, business development with public utilities, and habitat mitigation.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

1842 **Storage capacity of generalized networks.** Abbott, L.F.; Arian, Y. (Department of Physics, Boston University, Boston, Massachusetts 02215). *Physical Review [Section] A: General Physics;* 36: No. 10, 5091-5094(15 Nov 1987).

We discuss the thermodynamic phases and storage capacity of models which are extensions of the Hopfield-Little model of associative memory, generalized to allow for arbitrary polynomial Hamiltonians. The storage capacity increases as an exponential function of the highest power appearing in the polynomial Hamiltonian. We include the effects of replica symmetry breaking in our computations.

5501 Behavioral Biology

1843 **Territory size variation in the ovenbird: the role of habitat structure.** Smith, T.M.; Shugart, H.H. (Oak Ridge National Lab., TN). *Ecology;* 68: No. 3, 695-704(Jun 1987). Contract AC05-84OR21400.

The hypothesis that structural habitat cues are the proximate factor determining territory size was tested by examining the relationships among habitat structure, prey abundance, and intrapopulation variation in territory size in Ovenbirds (Seiurus aurocapillus). Territory size was negatively correlated with prey abundance, with territory size decreasing as prey abundance per unit area increased. In addition, there was a significant difference in prey abundance per unit area between territory sites and areas of the study site not occupied by ovenbirds. A regression of prey abundance with variables describing the habitat structure of territory sites was significant, with habitat structure accounting for 73% of the variation in prey abundance among territories. This regression analysis, in combination with an additional discriminant function analysis of habitat occupancy, suggested a gradient of habitat quality as a function of vegetation structure that is related to both habitat selection and variation in territory size. To determine the possible mechanisms responsible for the inverse relationship between prey abundance and territory size, several hypotheses were considered. A partial correlation analysis of territory size with prey abundance and predicted prey abundance supported a structural cues hypothesis, with variation in territory size being related to structural features of the habitat rather than prey abundance per se.

5502 Biochemistry

REFER ALSO TO CITATION(S) 442, 1332, 1864, 1878, 1941

1844 **(INIS-BR—801) Cholesterol esterification by mouse liver homogenate. Contribution to the study of ACYL-CoA: cholesterol ACYL transferase in mammalian liver.** Soares, M.G.C.B. (Pernambuco Univ., Recife (Brazil)). 1976. 59p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703544/JAW.

A cholesterol- esterifying enzyme from mouse liver has been partially characterized. The enzyme which showed optimum activity at pH 7,1 and required ATP and CoA, was identified as an acyl CoA: cholesterol acyl transferase (E.C.2.3.1.26). As a function of time the percentage of esterified cholesterol increased linearly during the first hour of incubation and continued to increase but not linearly with 4 hours, after which time no further net esterefication was observed. The relative concentration of esterified cholesterol remained constant between the fourth and twelveth hours of incubation but afterwards decreased when the incubation continued until 24 hours. The cholesterol- esterifying activity was 24,0+- 2,9 nmoles cholesterol esterified per gram tissue wet weight per minute. The mean percentages of free cholesterol esterified in and 24 hours respectively were 14,8+- 1,6 e 21,9+- 4,5. The subfractionation of labelled cholesteryl esters after one hour incubation of liver homogenate with 4-C/sup 14/-Cholesterol showed the order of preference for the formation of the different ester classes to be monounsatured > diunsatured ≅ saturated >> polyunsaturated. The properties of the enzyme frommouse liver do not markedly differ from those of the previously recorded ACAT activity of rat liver.

1845 **(INIS-mf—10846) Fourth national conference on biomedical physics and engineering with international participation, Sofia, November 3-4, 1984. Abstracts.** (Syyuz na Nauchnite Meditsinski Druzhestva v Bylgariya, Sofia; Republikansko Nauchno Druzhestvo po Biomeditsinska Fizika i Tekhnika, Sofia (Bulgaria)). Nov 1984. vp. (CONF-8411296—Absts.). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780117/JAW.

From 4. national conference on biomedical physics and engineering with international participation; Sofia, Bulgaria (3 Nov 1984).

Separate abstracts were prepared for inclusion in the appropriate data bases.

1846 **(KFK—4270) Functional and structural analysis of the DNA sequence conferring glucocorticoid inducibility to the mouse mammary tumor virus gene.** Skroch, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Bio- und Geowissenschaften). May 1987. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87753319/JAW.

In the first part of my thesis I show that the DNA element conferring glucocorticoid inducibility to the Mouse Mammary Tumor Virus (HRE) has enhancer properties. It activates a heterologous promoter - that of the β-globin gene, independently of distance, position and orientation. These properties however have to be regarded in relation to the remaining regulatory elements of the activated gene as the recombinants between HRE and the TK gene have demonstrated. In the second part of my thesis I investigated

the biological significance of certain sequence motifs of the HRE, which are remarkable by their interaction with transacting factors or sequence homologies with other regulatory DNA elements. I could confirm the generally postulated modular structure of enhancers for the HRE and bring the relevance of the single subdomains for the function of the element into relationship.

1847 **Comparison of two radiolabeled quinuclidinyl benzilate ligands for the characterization of the human peripheral lung muscarinic receptor.** Joad, J.P.; Casale, T.B. (VA Medical Center, Iowa City, IA). *Life Sciences;* **41**: No. 13, 1577-1584(28 Sep 1987). Contract AS05-82ER60039.

Quinuclidinyl benzilate, a muscarinic antagonist, has previously been used in its tritiated form ([^{3}H]-QNB) to study the lung muscarinic receptor. The authors investigated whether a newer iodinated form of QNB ([^{125}I]-QNB) of higher specific activity would be an appropriate ligand to study the human peripheral lung muscarinic receptor. Both the tritiated and iodinated ligands bound specifically to human lung at 23°C. At 37°C the specific binding of [^{3}H]-QNB increased slightly, but no specific binding of [^{125}I]-QNB was found. The data from multiple equilibrium binding experiments covering a wide range of radiolabeled QNB concentrations were combined and analyzed using the computer modeling program, LIGAND. The tritiated QNB identified a single affinity human lung binding site with a Kd of 46 +/- 9 pM. The iodinated QNB identified a single higher affinity human lung binding site of much smaller quantity. Competition studies comparing the binding of unlabeled QNB relative to labeled QNB indicated that unlabeled QNB had the same Kd as that measured for [^{3}H]-QNB, but a 5 log greater Kd than that measured for [^{125}I]-QNB. Other muscarinic receptor agonists and antagonists competed with [^{3}H]QNB, but not [^{125}I]-QNB for binding to muscarinic receptors with the expected magnitude and rank order of potency. 17 references, 2 figures, 2 tables.

1848 **Human thrombomodulin: complete cDNA sequence and chromosome localization of the gene.** Wen, D.; Dittman, W.A.; Ye, R.D.; Deaven, L.L.; Majerus, P.W.; Sadler, J.E. (Washington Univ. School of Medicine, St. Louis, MO). *Biochemistry;* **26**: No. 14, 4350-4357(14 Jul 1987).

A human umbilical vein endothelial cell cDNA library in λgt11 was screened for expression of thrombomodulin antigens with affinity-purified rabbit polyclonal anti-thrombomodulin immunoglobulin G (IgG) and mouse monoclonal anti-human thrombomodulin IgG. Among 7 million recombinant clones screened, 12 were recognized by both antibodies. Two of these, λHTm10 and λHTm12, were shown to encode thrombomodulin by comparison of the amino acid sequence deduced from the nucleotide sequence to the amino acid sequence determined directly from tryptic peptides of thrombomodulin. Thrombomodulin mRNA was estimated to be 3.7 kilobases in length by Northern blot analysis of endothelial cell and placental poly(A) + RNA. Thrombomodulin mRNA was not detected in human brain, HepG2 hepatoma cells, or the monocytic U937 cell line. Additional cDNA clones were selected by hybridization with the 1.2-kilobase insert of λHTm10. One isolate, λHTm15, contained a 3693 base pair cDNA insert with an apparent 5'-noncoding region of 146 base pairs, an open reading frame of 1725 base pairs, a stop codon, a 3'-noncoding region of 1779 base pairs, and a poly(A) tail of 40 base pairs. The cDNA sequence encodes a 60.3-kDa protein of 575 amino acids. The organization of thrombomodulin is similar to that of the low-density lipoprotein receptor, and the protein is homologous to a large number of other proteins that also contain EGF-like domains, including factor VII, factor IX, factor X, factor XII, protein C, tissue plasminogen activator, and urokinase. The gene for thrombomodulin has been localized to chromosome 20 by hybridization of cDNA probes to purified human chromosomes.

1849 **Metabolism of monoterpanes: metabolic fate of (+)-camphor in sage (Salvia officinalis).** Croteau, R.; El-Bialy, H.; Dehal, S.S. (Washington State Univ., Pullman). *Plant Physiology;* **84**: No. 3, 649-653(Jul 1987). Contract AM06-76RL02221;AT06-82ER12027.

The bicyclic monoterpene ketone (+)-camphor undergoes lactonization to 1,2-campholide in mature sage (Salvia officinalis L.) leaves followed by conversion to the β-D-glucoside-6-O-glucose ester of the corresponding hydroxy acid (1-carboxymethyl-3-hydroxy-2,2,3-trimethyl cyclopentane). Analysis of the disposition of (+)-[G-^{3}H]camphor applied to midstem leaves of intact flowering plants allowed the kinetics of synthesis of the bis-glucose derivative and its transport from leaf to root to be determined, and gave strong indication that the transport derivative was subsequently metabolized in the root. Root extracts were shown to possess β-glucosidase and acyl glucose esterase activities, and studies with (+)-1,2[U-^{14}C]campholide as substrate, using excised root segments, revealed that the terpenoid was converted to lipid materials. Localization studies confirmed the radiolabeled lipids to reside in the membranous fractions of root extracts, and analysis of this material indicated the presence of labeled phytosterols and labeled fatty acids (C_{14} to C_{28}) of acyl lipids. Although it was not possible to detail the metabolic steps between 1,2-campholide and the acyl lipids and phytosterols derived therefrom because of the lack of readily detectable intermediates, it seemed likely that the monoterpene lactone was degraded to acetyl CoA which was reincorporated into root membrane components via standard acyl lipid and isoprenoid biosynthetic pathways. Monoterpene catabolism thus appears to represent a salvage mechanism for recycling mobile carbon from senescing oil glands on the leaves to the roots.

1850 **Cloning of the cyo locus encoding the cytochrome o terminal oxidase complex of Escherichia coli.** Au, D.C.T.; Gennis, R.B. (Univ. of Illinois, Urbana). *Journal of Bacteriology;* **169**: No. 7, 3237-3242(Jul 1987). Contract AC02-80ER10682.

The structural genes encoding the cytochrome o terminal oxidase complex (cyo) of Escherichia coli have been subcloned into the multicopy plasmid pBR322 after the Mu-mediated transposition of the gene locus from the bacterial chromosome onto the conjugative R plasmid RP4. Introduction of cyo plasmids into strains (cyo cyd) lacking both terminal oxidases restored the ability of the strains to grow aerobically on nonfermentable substrates. Strains carrying the cyo plasmids produced 5 to 10 times more cytochrome o oxidase than did control strains. The gene products encoded by the cyo plasmids could be immunoprecipitated with monospecific antibodies raised against cytochrome o. The cloned genes will be valuable for studying the structure, function, and regulation of the cytochrome o terminal oxidase complex.

1851 **Regulation of β-1,4-endoglucanase synthesis in Thermomonospora fusca.** Lin, E.; Wilson, D.B. (Cornell Univ., Ithaca, NY). *Applied and Environmental Microbiology;* **53**: No. 6, 1352-1357(Jun 1987).

In Thermomonospora fusca YX, endocellulase synthesis varies over a 100-fold range depending on the carbon source used. This study shows that the variation is caused by two regulator mechanisms: an induction mechanisms that increases the rate of endocellulase synthesis about 20-fold and a growth rate-dependent repression mechanism that changes the rate of synthesis over a 6-fold range in both induced and noninduced cells. In T. fusca, endocellulase synthesis can be induced by cellulose, cellobiose, or cellodextrin. Cellulase is involved in inducer generation from cellulose. Growth rate-dependent repression can be reversed by limiting cultures for carbon, nitrogen, or, to a lesser extent, phosphorus. Further evidence for two separate regulatory mechanisms is provided by the isolation of mutants (CC-1 and CC-2) whose endocellulases are synthesized constitutively but are still sensitive to growth rate-dependent repression. These conclusions about total endocellulase synthesis were extended to the individual endocellulases by showing that three T. fusca endocellulases are coordinately regulated.

1852 **Analysis of a 5S rRNA gene cloned from Euplotes eurstomus.** Roberson, A.E.; Wolffe, A.; Olins, D.E. (Univ. of Tennessee Graduate School of Biomedicine Science Biology Div., Knoxville). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 2187(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

The macronucleus of the hypotrichous ciliated protozoan Euplotes eurystomus lends itself to the study of eukaryotic gene and chromatin structure because native macronuclear DNA exists as linear, gene-sized fragments between 400 and 20,000 bp in length.

The macronuclear chromatin, while arranged in a typical nucleosomal structure, is freely soluble in low ionic strength buffers without treatment by nucleases. Thus, specific genes may be enriched as native, intact chromatin molecules. The 5S rRNA gene from Euplotes has been cloned to facilitate investigation of 5S gene-chromatin following characterization of the gene at the DNA level. It has been demonstrated that the gene, while in circular or linear form, can be transcribed in vitro by a Xenopus oocyte nuclear extract. The transcript generated in vitro is 120 nucleotides in length and is synthesized by RNA polymerase III. Anti-Xenopus TFIIIA antibodies recognize a Euplotes macronuclear chromatin-associated protein which is ~ 80 KD in size. It has been established that the sequence of the telomere flanking the 5S gene in Euplotes eurystomus is the same telomeric sequence published for Euplotes aediculatus.

1853 **Kinetics of oxidation of horseradish peroxidase to Compound I by hypervalent organoiodine reagents.** White, R.E.; Blake, R.C. II. (Univ. of Connecticut Health Center, Farmington). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 2175(1 May 1987). (CONF-870644—). Contract FG05-85ER13339.

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

The rates of oxidation of horseradish peroxidase to Compound I by hypervalent organoiodine reagents have not been reported. Therefore, using stopped-flow kinetic techniques, they have investigated three classes of such reagents: iodosylbenzenes (ArI=O), iodobenzene diacetates (ArI(OAc)$_2$), and imidoiodobenzenes (ArI=NR). The second-order rate constants for the unsubstituted members of the three classes are each about 2×10^2 M^{-1} s^{-1} at 10°C, which is about four orders of magnitude smaller than the rate constants for oxidation of the enzyme by H_2O_2 and peroxyacids. The reason for such sluggish rates is unclear. A series of derivatives having different phenyl ring substituents was also investigated, for purposes of a Hammett plot. All three classes appear to solvolyze in the methanol stock solution to ArI(OMe)$_2$, which is the proximal oxidant of the hemeprotein.

1854 **Synthesis of 2-deoxy-[6-^{13}C]glucose.** Walker, T.E.; Unkefer, C.J.; Ehler, D.S. (Los Alamos National Lab., NM). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 2294(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

The authors have prepared 2-deoxy-D-[6-^{13}C]glucose which will be used to test the stability of 2-deoxy-D-glucose-6-phosphate in brain tissue. They chose to label 2-deoxy-D-glucose at C-6 because of the large chemical shift difference between C-6 in the free sugar and C-6 in the 6-phosphate analog. Their synthetic scheme is similar to that used for the synthesis of D-[6-^{13}C]glucose which involves the removal of C-6 from D-glucose followed by its replacement with ^{13}C. They first prepare the methyl α-furanoside using trifluoroacetic acid in methanol. This product is then treated with periodate which cleaves only between C-5 and C-6 to form a hydrated aldehyde which is reacted directly with K^{13}CN to form a mixture of nitriles. The enriched nitriles are reduced with hydrogen to a mixture of 6-aldehydo sugars using a 5% Pd on carbon catalyst. These sugars are reduced with $NaBH_4$ to a mixture of labeled methyl furanosides. Acid hydrolysis followed by chromatography yields 2-deoxy-D-[6-^{13}C]glucose in an overall yield of 10% from K^{13}CN.

1855 **NMR docking of a spin-labeled substrate analog into the X-ray structure Δ5-3-ketosteroid isomerase (KSI).** Kuliopulos, A.; Westbrook, E.M.; Talalay, P.; Mildvan, A.S. (Johns Hopkins Medical School, Baltimore, MD). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 1932(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

The spin-labeled steroid, 3-doxyl-5α-androstane-17β-ol (doxyl-DHT), binds at the substrate site of KSI as shown by linear competitive inhibition and by direct binding measurements based on changes in : (a) the EPR spectrum of the nitroxide, (b) T_1 of water protons and (c) T_1 and T_2 of carbon bound protons of KSI. These binding studies yield a stoichiometry of one doxyl-DHT per enzyme subunit with a K/sub D/ = 32μM. T_1 values of water protons indicate that the 3-doxyl end of doxyl-DHT is highly immobilized, yet exposed to solvent. Paramagnetic effects of the nitroxide on T_1 of several previously and newly assigned proton resonances of KSI yielded distances that were used to locate the nitroxide moiety at a unique position in the partially refined 2.5 angstrom resolution X-ray structure of the enzyme. The remaining portion of doxyl-DHT was then docked into the X-ray structure in a hydrophobic cavity of the enzyme. If they assume that the steroid substrate and doxyl-DHT bind at the same site, but with reversal of the 3- and 17-positions, then the phenolic -OH of Tyr-55 is optimally positioned to function as the general acid that protonates the 3-keto group of the substrate, facilitated by the negative end of a 10-residue α-helix. Similarly, the 4- and 6-positions of the steroid substrate are near Asp-38 and Asn-57, suggesting that Asp-38 functions as the general-base.

1856 **N-terminus conservation in the anchor polypeptide of a prokaryotic and eukaryotic alga.** Gantt, E.; Lipschultz, C.A.; Cunningham, F.X. Jr.; Mimuro, M. (Univ. of Maryland, College Park). *Plant Physiology, Supplement;* **83**: No. 4, 61(Apr 1987). (CONF-8707108—). Contract AS05-76ER04310.

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

Energy flow between the extrinsic phycobilisomes and the photosystems within thylakoids, is probably mediated by a blue anchor polypeptide. Polypeptides in the 94 kD range, purified by LiDS-PAGE from phycobilisomes of Nostoc and Porphyrdium cruentum, crossreacted with anti-Nostoc-94 (although weakly with the latter). Though rich in ASP and GLU, the polypeptides were very hydrophobic, and low in MET, CYS, and HIS. Partial sequence of the N-terminus shows considerable homology 1 - 5 - 10 - 15 - 20 N: (S)-V-K-A-S-G-G-S-S-V-A-(R)-P-Q-L-Y-Q-(G)-L-(A)-V-P: V-()-K-A-S-G-G-S-P-V-V-K-P-Q-L-Y-(K)-()-A-(S)- between the species. There is a lack of homology when compared with α and β polypeptides of allophycocyanin with rod linkers of phycobilisomes and other phycobiliproteins. Polypeptides of 94 and 92 kD from thylakoids of Nostoc, also immunoreactive with anti-94, were blocked at the N-terminus.

1857 **Changing kinetic properties of glucose-6-phosphate dehydrogenase from pea chloroplasts during photosynthetic induction.** Yuan, X.; Anderson, L.E. (Univ. of Illinois, Chicago). *Plant Physiology, Supplement;* **83**: No. 4, 7(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

The first enzyme of the oxidative pentose phosphate pathway, glucose-6-P dehydrogenase (EC 1.1.1.49), is inactivated when pea chloroplasts are irradiated. They have examined the kinetics of light inactivation of glucose-6-P dehydrogenase in intact chloroplasts during photosynthetic induction and the kinetic parameters of the active (dark) and less active (light) form of the dehydrogenase. Light inactivation of the dehydrogenase is rapid and occurs before photosynthetic O_2 evolution is measureable in intact chloroplasts. Likewise dark activation is quite rapid. The major change in the kinetic parameters of glucose-6-phosphate dehydrogenase is in maximal velocity. This light inactivation probably prevents operation of a futile cycle involving glucose-6-P, NADPH and oxidative and reductive pentose phosphate pathway enzymes.

1858 **Differential inactivation of alfalfa nodule glutamine synthetases by tabtoxinine-β-lactam.** Knight, T.J.; Unkefer, P.J. (Los Alamos National Lab., NM). *Plant Physiology, Supplement;* **83**: No. 4, 21(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

The presence of the pathogen Pseudomonas syringae pv. tabaci within the rhizosphere of nodulated alfalfa plants results in an increase in N_2-fixation potential and growth, but a 40-50% decrease in nodule glutamine synthetase (GS) activity, as compared to nodulated control plants. Tabtoxinine-β-Lactam an exocellular

toxin produced by Pseudomonas syringae pv tabaci irreversibly inhibits glutamine synthetase. Partial purification of nodule GS by DEAE-cellulose chromatography reveals two enzyme forms are present (GS/sub n1/ & GS/sub n2/). In vitro inactivation of the two glutamine synthetases associated with the nodule indicates a differential sensitivity to T-β-L. The nodule specific GS/sub n1/ is much less sensitive to T-β-L than the GS/sub n2/ enzyme, which was found to coelute with the root enzyme (GS/sub r/). However, both GS/sub n1/ and GS/sub n2/ are rapidly inactivated by methionine sulfoximine, another irreversible inhibitor of GS.

1859 **Effects of CO_2 concentration on rubisco amount, activity, and photosynthesis in soybean leaves.** Campbell, W.J.; Allen, L.H. Jr.; Bowes, G. (Univ. of Florida, Gainesville). *Plant Physiology, Supplement;* **83**: No. 4, 8(Apr 1987). (CONF-8707108—). Contract AI01-81ER60001.

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

Soybeans were grown at CO_2 concentrations ranging from 160 to 990 $\mu l\ L^{-1}$ in outdoor chambers receiving natural sunlight. Leaf soluble protein and total rubisco activity decreased with increasing growth CO_2, when expressed on a dry weight basis, but no decrease occurred on an area basis. On an area basis, leaf photosynthetic rates of plants grown at 330 and 660 $\mu l\ CO_2\ L^{-1}$, and measured over a range of intercellular CO_2 of 50 to 680 $\mu l\ CO_2\ L^{-1}$, were always greater in the high CO_2 grown plants. Rubisco content (percent of soluble protein) and total activity (soluble protein basis), remained unchanged over the range of growth CO_2. Since rubisco content and total activity per m^2 were independent of growth CO_2 concentration, the enhanced rate of photosynthesis of leaves grown at high CO_2 was apparently not due to an increase in rubisco amount or activity. Soybean grown at high CO_2 has an extra palisade cell layer per unit leaf area. Thus, the greater photosynthetic rates of high CO_2 grown leaves may result from an enhanced ability of CO_2 to gain access to rubisco via increased total mesophyll cell surface area.

1860 **Extensins in graminaceous monocots and dicots compared.** Kieliszewski, M.; Lamport, D.T.A. (Michigan State Univ., East Lansing). *Plant Physiology, Supplement;* **83**: No. 4, 109(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

Is the cellulose-extensin warp-weft model of primary cell wall organization generally applicable, or restricted to dicots? Although wall-bound hydroxyproline is usually a quantitative measure of extensin content, it is not definitive at low hyp levels typical of graminaceous monocots. Therefore the authors searched for putative soluble extensins ionically-bound to the cell wall of maize cell suspension cultures. Fractionation of $AlCl_3$ eluates on cellex-P, Cellex-E, and Superose-6 gave two HRGPs CEV and CE1 which compositionally resembled extensins rather than the arabinogalactan HRGPs. CEV and CE1 did not react with Yariv's antigen, but did cross-react with antibodies raised against tomato extensin. A tryptic peptide map of CEV gave some major peptides enriched in hydroxyproline and proline residues, indicating peptide periodicity. TEM of the low-angle shadowed protein gave flexuous rodlike molecules of 80 nm contour length. This is the best evidence to date for extensin in monocots.

1861 **Reaction of HO_2/O_2^- with α-tocopherol in ethanolic solutions.** Arudi, R.L.; Sutherland, M.W.; Bielski, H.J. (Brookhaven National Lab., Upton, NY). pp 26-32 of Oxy radicals and their scavenger systems. Volume I. Molecular aspects. Cohen, G.; Greenwald, R.A. (eds.). New York, NY; Elsevier Science Publishing Company, Inc. (1983).

Tocopherols as a class of compounds react with lipid radicals to terminate chain propagation reactions in vivo. The possibility also exists that these antioxidants also prevent chain oxidation reactions by intercepting the initiating radicals, e.g., HO_2. The reactivity of both HO_2 and O_2^- towards α-tocopherols was investigated using stop-flow-techniques. The results indicate that HO_2 is the biologically active partner of the HO_2/O_2^- pair. 23 references, 1 figure.

5504 Genetics

REFER ALSO TO CITATION(S) 1848, 1886, 1895, 1902, 1903, 1904, 1906, 1909

1862 **Genetic locus essential for formate-dependent growth of Bradyrhizobium japonicum.** McClung, C.R.; Chelm, B.K. (Michigan State Univ., East Lansing). *Journal of Bacteriology;* **169**: No. 7, 3260-3267(Jul 1987). Contract AC02-76ER01338.

A genetic locus essential for the formate-dependent growth of Bradyrhizobium japonicum was isolated by complementation of ethyl methanesulfonate-induced mutants with a cosmid gene library of B. japonicum DNA. Three related cosmids containing 18.7 kilobase pairs of B. japonicum DNA in common were identified as being able to restore formate-dependent growth capability to mutants lacking either ribulosebisphosphate carboxylase or both ribulosebisphosphate carboxylase and phosphoribulokinase activities. To further localize the complementing gene(s), a series of four deletions spanning a total of 16.1 kilobase pairs were introduced into the B. japonicum chromosome. Each resulting deletion mutant lacked formate dehydrogenase activity and lacked ribulosebisphosphate carboxylase activity and immunologically detectable protein. Three of the four also lacked phosphoribulokinase activity. Two other mutants in which the deletion-bearing recombinant plasmid had integrated into the chromosome also lacked ribulosebisphosphate carboxylase activity and protein and phosphoribulokinase activities. The genetic locus defined by these mutants could contain the structural genes for these enzymes or a regulatory gene(s) controlling their expression or both.

1863 **Chromosomal locations of three Bacillus subtilis din genes.** Gillespie, K.; Yasbin, R.E. (Univ. of Rochester School of Medicine and Dentistry, NY). *Journal of Bacteriology;* **169**: No. 7, 3372-3374(Jul 1987). Contract AC02-81ER60017.

Previously isolated DNA damage-inducible (din) genes of Bacillus subtilis have been mapped on the bacterial chromosome by bacteriophage PBS1-mediated transduction. The din genes have been localized to three positions on the B. subtilis map. dinA cotransduction with the hisA locus was 80%, while dinC cotransduction with this marker was about 56%. dinB is unlinked to hisA, but its cotransduction with the dal-1 and purB loci was 84 and 22%, respectively.

1864 **Mutants in Arabidopsis thaliana with altered shoot gravitropism.** Bullen, B.L.; Poff, K.L. (Michigan State Univ., East Lansing). *Plant Physiology, Supplement;* **83**: No. 4, 20(Apr 1987). (CONF-8707108—). Contract AC02-76ER01338.

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

A procedure has been developed and used to screen 40,000 m-2 seedlings of Arabidopsis thaliana for strains with altered shoot gravitropism. Several strains have been identified for which shoot gravitropism is considerably more random than that of their wild-type parent (based on frequency distribution histograms of the gravitropic response to a 1 g stimulus). One such strain exhibits normal hypocotyl phototropism and normal root gravitropism. Thus, the gravitropism pathway in the shoot contains at least one mutable element which is not required for root gravitropism.

1865 **Potential use of gradient denaturing gel electrophoresis in obtaining mutational spectra from human cells.** Thilly, W.G. (Massachusetts Institute of Technology, Cambridge). pp 511-528 of Role of chemicals and radiation in the etiology of cancer/carcinogenesis. Volume 10. A comprehensive survey. Huberman, E. (ed.). New York, NY; Raven Press (1985). Contract AC02-77EV04267.

A method is described to isolate mutations in DNA in human cells. When a double-stranded DNA migrates through an electric field on an electrophoretic gel, it is compact hydrodynamic structure relative to the same material in a melted form. Normally the solution in electrophoretic gels is uniform, but a way has been devised to set up a stable gradient of increasing solute concentra-

tion in the direction of DNA motion. Thus, as a double-stranded DNA molecule is drawn by the electric field into higher and higher concentrations of urea/formamide, it will eventually reach a point at which the concentration is high enough to melt the lower-melting-point region. The melting results in an essentially immobile structure within the gel so that the position at which the DNA molecule stops on the gradient gel is determined by its melting point, which is uniquely determined by its nucleotide sequence. A single base pair substitution within a low melting point sequence of some 100 base pairs changed the expected melting point by 0.4°C and resulted in about a 2-cm displacement under appropriate denaturing gel conditions. This expectation leads to the idea that if a mixture of DNA sequences derived from point mutations within the same restriction fragment were permitted to anneal with a complementary wild-type sequence, the melting point of each type of heteroduplex would differ depending on the kind and position of each mutation.

5505 Metabolism

REFER ALSO TO CITATION(S) 473, 1804

1866 **(INIS-BR—713) Toxic metabolities of disulfoton: behavior in bean-seedlings, in soil, and in nutrient solution.** Andrea, M.M. de. (Sao Paulo Univ., Piracicaba (Brazil). Escola Superior de Agricultura Luiz de Queiroz). Oct 1986. 126p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703465/JAW.

The absorption, translocation and degradation in bean-seedlings of three toxic metabolites of the pesticide /sup 14/C- disulfoton from nutrient solution or three different types of Brazilian soils is studied. (M.A.C.).

1867 **Seasonal energy, water, and food consumption of Negev Chukars and sand partridges.** Kam, M.; Degen, A.A.; Nagy, K.A. (Ben-Gurion Univ. of the Negev, Beer Sheva, Israel). *Ecology;* **68**: No. 4, 1029-1037(Aug 1987). Contract AC03-76SF00012.

Chukars (Alectoris chukar) and Sand Partridges (Ammoperdix heyl), two ground-dwelling phasianids, are permanent residents of the Negev desert and are sympatric over much of their ranges. Sand Partridges (body mass = 150-250 g), however, inhabit only arid and very arid areas, whereas Chukars (m/sub b/ = 350-600 g) are widely distributed and inhabit deserts only at the margins of their ranges. They compared some of the desert adaptations of these phasianids by measuring the seasonal field metabolic rates (FMR) and water influxes (using doubly labelled water), diet selection, and food requirements of free-living Chukars and Sand Partridges at a site where both species occurred. Both species showed adaptation in the form of low energy metabolism, which ranged from 43 to 81% of that expected for birds of similar body mass. During summer, Sand Partridges had lower energy expenditures (5.47 kJ x g/sup -0.61/ x d^{-1}) and water influxes (72.3 mL kg/sup -0.75/ d^{-1}) than did Chukars (6.42 kJ g/sup -0.61/ d^{-1} and 93.5 mL x kg/sup -0.75/ x d^{-1}, respectively), indicating more pronounced adjustments to arid conditions in the desert specialist. However, both species obtained more than half of their water influx in summer by drinking. Their summer diet was relatively dry, consisting mainly of seeds (80%) along with some green vegetation (18%) and, in Chukars, occasional arthropods. This situation changed abruptly after winter rains, which induced germination and reduced the availability of seeds. Chukars were unable to maintain energy balance in the face of low ambient temperatures and a diet (90% green vegetation) that contained much water but comparatively little energy, and they mobilized fat reserves to meet energy requirements. Most Sand Partridges left the study area after winter rains, apparently migrating to the lower elevation, warmer, and drier Arava (part of the Rift Valley).

5506 Medicine

REFER ALSO TO CITATION(S) 429, 1908, 1931, 1932, 2460

1868 **(CEA-CONF—8399) Measurement of regional cerebral glucose utilization in man by positron emission tomography.** Baron, J.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). May 1986. 20p. (In French). (CONF-8605277—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752751/JAW.

From Diabetology meeting at Hotel Dieu Hospital; Paris, France (29 May 1986).

The various methods available for the study of regional cerebral glucose consumption in man by positron emission tomography are described and their applications, limitations and principal physiopathological results are presented.

1869 **(DOE/ER/60200—T1) K-edge subtraction angiography with synchrotron x-rays: Final technical report, [February 1, 1984 to January 31, 1987].** Hofstadter, R. (Stanford Univ., CA (USA)). Sep 1987. Contract AS03-84ER60200. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014546/JAW.

The aim was the development of an angiographic method and appropriate equipment for imaging with x-rays the coronary arteries in a non-invasive manner. Successive steps involved studies with phantoms, live animals and finally with human subjects. Clinical evaluation of human coronary arteries remains a goal of this and a continuing project, and steps along the way to such an achievement are in process. Transvenous injection of a dye using the method of iodine dichromography near 33.2 keV, the K-edge of iodine, forms the basis of the method. 11 refs.

1870 **(FRNC-TH—2384) Evaluation and quality control of digital subtraction angiography systems.** Louisot, P. (Toulouse-3 Univ., 31 (France)). Apr 1986. 178p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87752724/JAW.

After reviewing the development of systems used in angiography, we rewind the medical interest and describe the steps of an angiographic examination. The following chapter is dedicated to the techniques used for the digitalization of video images. The components of the system involved in the image acquisition are thoroughly investigated in chapter 4. Then, we analyse the capabilities of the machines available in France in 1985. Chapter 6 is devoted to the criteria of quality in digital imaging. In order to assign qualitative values to the above criteria, we design a control procedure which is described in chapter 7. The procedure thus allows the estimate of the physical performances of angiographic digital subtraction systems.

1871 **(INIS-mf—10710) Development of a radioimmunoassay for triamcinolone acetonide in horse plasma.** Gylstorff, B. (Muenchen Univ. (Germany, F.R.). Fachbereich Tiermedizin). 26 Feb 1982. 173p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87753311/JAW.

A radioimmunoassay (RIA) was developed for the detection of triamcinolone acetonide (TAAc) in equine blood plasma. These antibodies exhibited cross reactions of 0,015% with cortisol and of 0,1% with other endogenous glucocorticoids. Four different synthetic corticosteroids interfered in a range of 0,21 to 0,93%. In vitro 86 of TAAc could be recovered. This method proved sufficient reproducibility down to a limit of 131,7 fmol/ml = 57,2 pg/ml. The TAAc RIA is suitable for the detection of a TAAc application particularly during the 1st day p.i. The results may obtain a higher limit of confidence by the simultaneous demonstration of cortisol suppression. By the use of this test more detailed conclusions may be drawn about presence and duration of a pharmacodynamic action originating from the TAAc depot. (orig./TRV).

1672 **(INIS-mf—10717) Radioimmunoassay for secretin - methodology, basal and stimulated hormone concentration in plasma of rats, dogs, rabbits and humans.** Wittmann, J.K. (Muenchen Univ. (Germany, F.R.). Fachbereich Tiermedizin). 25 Feb 1983. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753310/JAW.

A radioimmunoassay for measurement of secretin in the plasma of experimental animals and man has been developed by means of the so-called stripping procedure (pre-treatment of plasma with Quso). The detection limit is about 7 pg/ml at a final dilution of 1:630 000 and an equilibrium constant of 2.1 x 10/sup -11/ L/M. By means of this system plasma secretin in the species examined can be measured reliably. The coefficients of variation are (percent): The within assay precision (intra-assay) 12, the between assay precision (inter-assay) 23. The median of basal venous plasma secretin are (pg/ml) dog 16, rabbit 0, rat (aorta) 0, rat (porta) 31, man 0. From these studies it is concluded that a) as a consequence of unspecific interference of plasma particles with the secretin RIA-system only a previous removal of these interfering factors leads to reliable test results; should this pre-requisite be neglected falsely too high results are to be expected; b) plasma secretin rises if there is either hydrochloric acid present in the duodenum or if gastric together with food particles reaches the duodenum; c) at least in the dog there may be different molecular species of secretin circulating in the peripherical plasma, however the biological role of these is unknown at present. (orig./TRV).

1673 **(INIS-mf—10977) Longitudinal emission tomography of thyroid and heart. A technical evaluation of three imaging devices.** Giessen, J.W. van. (Technische Univ. Delft (Netherlands)). 4 Dec 1986. 140p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703759/JAW.

In this thesis three devices are discussed for longitudinal emission tomography, one of which has been developed for myocardial imaging and the other two for thyroid imaging. Longitudinal emission tomography is a technique which enables three-dimensional reconstruction of the radioactivity distribution within an organ from two-dimensional distributions on a detector surface. In Ch. 1 a general survey is given of the clinical environment in which the devices will be used. Ch. 2 discusses a well-known technique for myocardial imaging: seven-pinhole tomography. In Ch. 3 this technique is applied to imaging of the thyroid. Three different reconstruction methods have been applied to the data collected with the system (from phantoms as well as from patients) and the results have been evaluated. Ch. 4 discusses simulation studies which were carried out in order to investigate the potentialities of a time-coded aperture (TCA) system designed for thyroid tomography. In Ch. 5 a prototype is tested of the time coded aperture in a clinical environment. The last chapter presents a comparison between the (thyroid) 7P collimator and the TCA device. (Auth.). Includes Dutch summary

1674 **(INIS-mf—10991) High-resolution computed tomography of the paranasal sinuses, pharynx and related regions. Impact of CT-identification on diagnosis and patient-management.** Maatman, G. (Rijksuniversiteit Utrecht (Netherlands)). 9 Sep 1986. 185p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE87703576/JAW.

The aim of the study was to facilitate the identification of anatomic structures and the interpretation of pathologic changes in CT-images of paranasal sinuses, pharynx and related regions. Secondly the impact of CT on diagnosis and patient management was analyzed. 134 patients were examined with pathological processes of paranasal sinuses, and pharynx, nasal or oral cavity. The results of this examination are discussed. (Auth.). Includes Dutch summary

1675 **(LA-UR—87-3026) Near-real-time radiography detects 0.1% changes in areal density with 1-millimeter spatial resolution.** Stupin, D.M. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 14p. (CONF-870691—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000534/JAW.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (21 Jun 1987).

Using digital subtraction radiography, the author detects an 0.1% change in areal density in a phantom. Areal density is the product rho x, where rho is the material density and x is the material thickness. Therefore, it is possible to detect an 0.1% difference in either density or thickness in unknown samples. A special x-ray television camera detects the areal density change on the phantom. In a difference image, formed by subtracting the 128-television-frame averages of the phantom image from the phantom-and-step image, the step is resolved with a 1-mm spatial resolution. Surprisingly, crossed 2-μm-diam tungsten wires that overlie the phantom are also detected. This procedure takes a few seconds. The performance of any digital imaging x-ray system will improve by using the averaging and digital subtraction techniques. 8 refs., 6 figs.

1676 **(RERF-TR—14-85) Acquired intrathoracic kidney in thoracic kyphosis.** Murayama, Sadayuki; Kawashima, Akira; Ohuchida, Toshiyuki; Russell, W.J. (Radiation Effects Research Foundation, Hiroshima (Japan)). Dec 1986. 7p. (In Japanese and English). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750068/JAW.

Two cases of acquired intrathoracic kidney associated with thoracic kyphosis are reported, with emphasis on the radiographic manifestations. A search of the scientific literature disclosed that the acquired type of this abnormality is rare. The importance of recognizing this entity from a differential diagnostic standpoint is underscored.

1677 **Excimer laser phototherapy for the dissolution of abnormal growth.** Gruen, D.M.; Young, C.E.; Pellin, M.J. (to Dept. of Energy, Washington, DC). US Patent 4,686,979. 18 Aug 1987. Filed date 19 Feb 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method is described of severing a human tissue comprising the steps of providing a laser-transmitting member composed of glass, exposing at least a portion of the tissue to the laser-transmitting member, and directing a laser having a wavelength of about 290-400 through the laser transmitting member to the tissue portion for a time and at an intensity level sufficient to penetrate the tissue and separate a tissue portion from remaining tissue.

1678 **Structure of bound water and refinement of acid metmyoglobin.** Raghavan, N.V.; Schoenborn, B.P. (Brookhaven National Lab., Upton, NY). pp 247-259 of Neutrons in biology. Schoenborn, B.P. (ed.). New York, NY; Plenum Publishing Corporation (1984).

In the structure of myoglobin as determined from x-ray diffraction data the positions of the hydrogen atoms cannot be described, but they are important factors in determining the interactions of the heme with its environment. Neutron diffraction work, done in this laboratory, has demonstrated that hydrogen and deuterium positions can be located. In addition to the localization of H and D, neutron diffraction provides a unique method for studying the water structure because of the strong scattering ability of D_2O. The scattering factor of deuterium is nearly twice as large as that of hydrogen, and it increases the visibility of water molecules in Fourier maps, so that in a neutron map a water molecule appears about three times as strong as in an equivalent electron-density maps. The reciprocal-space refinement of acid metmyoglobin and in particular the details of the water structure and hydrogen exchange are presented here.

5507 Microbiology

REFER ALSO TO CITATION(S) 442, 468, 526, 1851

1679 **(SERI/SP—231-3071, pp 22-40) Screening microalgal for biomass production potential: protocol modification and evaluation.** Barclay, B.; Nagle, N.; Terry, K. Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

The authors laboratory developed and tested a collection and screening protocol to isolate microalgal strains for biomass production applications. The protocol involved a process for exposing nutrient enriched collection site waters (from shallow, inland saline habitats) to high light intensities (20-50% of sunlight) and elevated temperature (30 C) on a rotary screening apparatus. The purpose of

the protocol was to select for strains with fast growth rates that could tolerate the high light intensities and temperatures anticipated in mass cultivation systems in the southwestern US. This protocol has proven successful in identifying several excellent strains which exhibit fast growth rates in combination with a wide range of salinity and temperature tolerance. The dominant genera isolated by the protocol include lipid producing species of Chaetoceros, Amphora, Monoraphidium, Nitzschia, Thalassiosira, and Navicula. The physiological attributes of several of these strains are reviewed and discussed in light of the chemical and physiological selection factors that appeared to be operating in the protocol. The effectiveness of an implemented improvement in the protocol is also discussed. Efforts to adapt the protocol to isolate cool-water (15 C) adapted strains are described. 15 references, 11 figures, 2 tables.

1880 (SERI/SP—231-3071, pp 41-52) **Collection and screening of microalgae for lipid production: possible use of a flow cytometer for lipid analysis.** Berglund, D.; Cooksey, B.; Cooksey, K.E.; Priscu, L.R. (Montana State Univ., Bozeman). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Thermotolerant algae isolated in axenic culture from sites in Yellowstone National Park produce neutral lipid as 35-54% of their dry weight when grown at 35 C. They have found that the marine diatom Amphora coffeaeformis can be stained with the fluorophore Nile Red and that the lipid content of the stained cells can be related to their fluorescence. The fluorescence of unfixed cells of A. coffeaeformis fades with time, however chemical fixation of the cells reduces the rate of fading. 8 references, 4 figures, 5 tables.

1881 (SERI/SP—231-3071, pp 53-66) **Collection of high energy yielding strains of saline microalgae from southwestern states.** Sommerfeld, M.R.; Ellingson, S.B. (Arizona State Univ., Tempe). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

The primary goal of this research is to obtain high performance microalgal species from nature that may serve as the raw material required to make microalgae culture technology a plausible approach to fuel production. Microalgal and water samples were obtained from 103 sites in Arizona, California, Nevada, New Mexico, Texas, and Utah. Ionic analysis of the water revealed that the relative anion and cation composition of the surface waters sampled was relatively similar to the artificial SERI Type I and Type II Media used as the standardized media for screening and growth rate experiments. Approximately 1600 individual isolates of microalgae were obtained from surface waters in the Southwest. Of the initial 57 algae screened for growth characteristics, the majority grew best at the lower salinities in both SERI Type I and II Media. Growth rates for 15 isolates exceeded one doubling/day and for five strains exceeded two doublings/day. In nutrient-sufficient batch cultures 14 strains yielded an average lipid concentration of 11.1% of ash-free dry weight. The highest yield was over 26%. Laboratory efforts are now being directed toward growth and chemical characterization of strains within specific taxonomic groupings such as the diatoms. Of 22 diatom strains that have demonstrated rapid growth, one-third of the strains exceeded one doubling/day and several gave positive indications of lipid accumulation. Future research will focus on evaluation of the effects of nitrogen and silicon deficiency and other growing conditions on lipid production in those strains exhibiting rapid growth. 22 references, 5 figures, 2 tables.

1882 (SERI/SP—231-3071, pp 67-89) **Screening and characterizing oleaginous microalgal species from the southeastern United States.** Tadros, M.G. (Alabama A & M Univ., Normal). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Two collection trips were made and samples collected from the intertidal region and near islands along coasts of Florida, Alabama, and Mississippi. Seventy-five algal strains were isolated and five fast growers and lipid accumulators were characterized: Navicula (260), Navicula (264), Nitzschia (225), Cylindrotheca (204), and Chlorococcum (183). Three of the diatoms are of particular interest because of their high growth rate, tolerance to temperature and salinity and ability to accumulate high lipids. Navicula (260), and Navicula (264) cultures limited in nitrogen and silicon showed 34.6, 32.4, and 42.5, 46.5% lipid respectively. While, nitrogen-limited cells of Nitzschia (225) exhibited higher lipids (42.6%) than silica-limited cells (32.6%). 18 references, 11 figures, 3 tables.

1883 (SERI/SP—231-3071, pp 90-104) **Collection of high energy yielding strains of saline microalgae from the Hawaiian Islands.** York, R.H. Jr. (Hawaii Institute of Marine Biology, Kaneohe). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Microalgae were collected from 48 locations in the Hawaiian Islands in 1985. The sites were an aquaculture tank; a coral reef; bays; a geothermal steam vent; Hawaiian fish ponds; a Hawaiian salt punawai (well); the ocean; river mouths; saline lakes; saline pools; saline ponds; a saline swamp; and the ponds, drainage ditches and sumps of commercial shrimp farms. Conductivities of the water ranged from 6.00×10^3 micromhos cm^{-1} to 3.85×10^5 micromhos cm^{-1}, and temperatures ranged from 10.5 C to 62.0 C. Single cells or colonies of microalgae were isolated into media in glass culture tubes incubated in fluorescent light in the laboratory, and into fluorohalocarbon plastic bags transmitting full-spectrum sunlight outdoors. From 4800 isolations, 100 of the most productive clones were selected to be maintained by periodic transfer to sterile medium. Five clones were tested for growth rate and production in a full-spectrum-transmitting solarium. The cultures were bubbled with carbon dioxide and air. Temperatures ranged from 17.7 C to 42.8 C. The highest growth rates were 2.12 doublings/day for Chaetoceros sp. clone SH 9-1, and 1.43 doublings/day for Cyclotella sp. clone 14-89. The highest production was 31 g dry weight m^{-2} day^{-1} for the Chaetoceros sp., and 33 g dry weight m^{-2} day^{-1} for the Cyclotella. Clones isolated in full-spectrum, high-intensity sunlight and high temperatures were the most productive in tests simulating conditions expected in large-scale microalgal production facilities. 4 figures, 3 tables.

1884 (SERI/SP—231-3071, pp 105-121) **Picopleuston algae from the Caribbean region.** Lewin, R.A.; Burrascano, C.; Cheng, L. (Univ. of California, San Diego). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Picoplankton algae, 1-5 micrometers in diameter, include both prokaryotes and eukaryotes. Among the former (Cyanophytes), some can float by making gas vacuoles. Among the latter, some can swim by using flagella, others float because of stored oil. Nannochloropsis (Eustigmatophyta) produces a lot of oil, much of it hydrocarbon. By differential filtration and flotation enrichment cultures they have collected and examined the floating picoplankton of some 200 samples of inshore marine waters from subtropical and tropical sites, chiefly in the Caribbean. Pure cultures have been isolated and grown in defined media: their lipid production is being assessed under various conditions of culture. Some may ultimately prove of economic value as a source for liquid fuel. 18 references.

1885 (SERI/SP—231-3071, pp 122-136) **Collection and characterization of saline microalgae from south Florida.** Ryther, R.H.; Carlson, R.D.; Pendoley, P.D.; Jensen, P.R. (Harbor Branch Foundation, Ft. Pierce, FL). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Sixty-one species of microalgae were isolated from saline habitats of Florida and the growth of 110 species was assessed in desert saline waters. Twenty-five of the species met their initial criteria for good growth. The growth for 4 of these species were examined in more detail on a cross temperature-salinity gradient and 8 species were examined for proximate chemical composition. The influence of individual carbon species concentration on the potential yield of microalgae was also examined in an experimental design that decoupled carbon concentration from pH effects. 16 references, 4 figures, 5 tables.

1886 (SERI/SP—231-3071, pp 137-138) **Physiological variability in strains of Chaetoceros muelleri.** Johansen, J.R.; Barclay, W.R. Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

It is likely that at some time in the future, genetic engineering of selected algal strains will be performed to improve lipid production in strains isolated from the field. Before this work can be undertaken, the degree of genetic variability present in closely related algal strains, representing single species or species complexes, must be established. In order to assay genetic variability, the authors are currently comparing the physiology, morphology, and biochemistry of a number of strains of Chaetoceros muelleri isolated from various locations in the western US. This species was chosen because representative strains are generally euryhaline, tolerant of high temperatures, rapid growing, and high in lipid content. Presently, the growth response of three strains of C. muelleri to water type, conductivity, and temperature has been determined. The authors plan to continue the study of variability in C. muelleri and related species, having 38 strains currently in their culture collection from which to choose. Selected species will be characterized in terms of: (1) growth response to water type, conductivity, and temperature, (2) growth response to light intensity, (3) lipid content, (4) sterol composition, (5) pigment ratios, and (6) enzymatic differences as determined by starch gel enzyme electrophoresis.

1887 (SERI/SP—231-3071, pp 139-168) **Factors affecting the photosynthetic yield of microalgae.** Weissman, J.C.; Goebel, R.P. (Microbial Products, Inc., Fairfield, CA). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

The objectives include the outdoor cultivation of prescreened algal species for an evaluation of productivity potential and competitiveness, development of harvesting technologies, engineering evaluation and design of photobioreactors, and physiological characterization of strains in the laboratory to assess factors which affect outdoor yield. There is substantial interplay among these objectives, especially the first and the last. Twelve prescreened species of algae were grown in 1.4 m^2 pond reactors, including six diatoms and six chlorophytes. Four of the diatoms (three strains of Chaetoceros and a Cyclotella) could be cultivated for as long as was attempted, from 28 to 125 days, at average productivities of about 30 gm^{-2} d^{-1}. The other two diatoms (Amphora sp. and Navicula sp.) were as productive but could not be sustained in culture. Productivity from the chlorophytes was generally only one-half to one-third as much as from the diatoms. Only species of one genus, Tetraselmis, endured in the outdoor culture tanks. Factors which were found to affect both the yield and longevity of outdoor mass culture were photoinhibition, oxygen inhibition, temperature, pH, pCO_2, dilution rate, and nutrient status. Species which could not be sustained were often found to be unstable at high irradiance and/or high oxygen. Usually inability to adapt to the pond environment resulted quickly in the loss of a strain. In one case, competition from another species determined the longevity of a culture. The factor which determines the maximum yield is most likely the irradiance at which photosynthesis saturates. How to determine this and how to optimize it still remain elusive goals. 28 references, 7 figures, 11 tables.

1888 (SERI/SP—231-3071, pp 169-183) **Integrated field-scale production of oil-rich microalgae under desert conditions.** Arad, S. (Ben-Gurion Univ. of the Negev, Beer-Sheva, Israel). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

A 100-m^2 pond was operated under desert conditions at Sede Boqer with a halotolerant oil-producing alga, Isochrysis. The pond was operated by three Israeli research groups, Ben-Gurion University, Israel Institute of Technology and the Oceanographic Institute. The pond was run for 45 days during August and September, 1985. The process included: algal cultivation (growth, biomass production, maintenance of uni-algal culture), semicontinuous operation achieved by bleeding, and harvesting. Harvesting was achieved by flocculation with $FeCl_3$ and dissolved air flotation. The harvested slurry was dried and chemically analyzed, and lipids were extracted. Biomass production was 23.5 g per square meter per day, and lipid production of 6 g per square meter per day. The operation demonstrated the feasibility of cultivating microalgae outdoors for production of oil on a field scale. It revealed the necessity to optimize the system as a whole, because of the dependence of the phases upon each other. The development of an applicable process of lipid extraction from algae requires continuation of integrated optimization of the whole process. 24 references, 3 figures, 5 tables.

1889 (SERI/SP—231-3071, pp 184-198) **Development of an outdoor system for production of lipid-rich halotolerant microalgae.** Boussiba, S.; Vonshak, A.; Cohen, Z.; Richmond, A. (Ben-Gurion Univ. of the Negev, Sede-Boqer Campus, Israel). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

The cell concentration in cultures of Nannochloropsis salina was optimized with respect to its effect on the overall output rate. Under outdoor steady-state conditions at a cell concentration of 350 mg l^{-1} (dry weight), the overall output rates were 24.5 g x m^{-2} day^{-1} biomass and 4.0 g x m^{-2} day^{-1} lipids. With Isochrysis galbana, the pond depth and mixing regime had no significant effect on the biomass output rate. The greatest output rate was observed for this organism at a cell concentration of 350 mg l^{-1} at a medium depth of 12.8 cm where the total biomass output was 28.1 g x m^{-2} day^{-1} and that of lipids was 6.4 g x m^{-2} day^{-1}. 7 references, 1 figure, 5 tables.

1890 (SERI/SP—231-3071, pp 199-208) **Development of outdoor raceway culture technologies for oil-rich haltolerant algae.** Ben-Amotz, A. (Israel Oceanographic & Limnological Research, Haifa, Israel). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Growth rate studies have been completed in illuminated chemostats for the diatom C. gracilis in comparison to a green alga Nannochloris atomus, using Mediterranean sea water at different temperatures from 15 to 40°C, at different pHs from 5.5 to 10, at different nutrient concentrations of nitrate, phosphate and silicate, at different salinities from 0.5 M to 1.5 M NaCl, and at different light intensities from 50 to 500 $\mu E/m^2$ sec. Optimum growth of C. gracilis under those laboratory conditions was attained in sea water medium at 28°C, pH 7-8, 5 mM NO_3^-, 0.2 mM PO_4^{3-}, 0.1 mM silicate, under a light intensity of 100 $\mu E/m^2$ sec. Optimization studies have been conducted outdoors in microponds of 0.35 m^2 each equipped with air bubbling for mixing and pH control by CO_2 supply. Growth rate, productivity and photosynthetic efficiency have been assayed since June, 1985 with C. gracilis. A maximal productivity of 40 g AFDW/m^2 day at a photosynthetic efficiency of 9.5% was noted during the fall season. A minimal productivity of around 13 g AFDW/m^2 day at a photosynthetic efficiency of 5% was noted during the winter season. Maximum productivity was observed by diluting the culture from the initial stage of the stationary phase (0.4 g AFDW/l) to any stage of the logarithmic phase above 0.04 g AFDW/l. Lipid fractionation of the total lipid extract of C. gracilis revealed the presence of long chain alkenones and triglycerides as the major lipid components of the diatom. 10 references, 2 figures, 6 tables.

1891 (SERI/SP—231-3071, pp 209-226) **Continuous microalgae production in shallow raceways at high productivities.** Laws, E.A. (Univ. of Hawaii, Honolulu). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Saline microalgae grown in an experimental flume culture system at the University of Hawaii have achieved daily production rates of 27-37 g ash-free dry weight (AFDW) per square meter and photosynthetic efficiencies of 9.1-10.7% based on visible irradiance over periods of 44-78 days. A key feature of the system is the use of foil arrays to effect systematic vertical mixing of the culture through the production of vortices. Photosynthetic efficiencies with the foil arrays in place were a factor of 1.35 times the photosynthetic efficiencies without foil arrays. An analysis of variance of production results over a 5 1/2 month period showed that the enhancement of production with the foil arrays in place was statistically significant at better than 99% confidence. 1 reference, 6 figures, 6 tables.

1892 (SERI/SP—231-3071, pp 249) **Nutritional requirements for maximal growth of oil producing microalgae.** Rhyne, C. (Jackson State Univ., MS). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

The purpose of this study was to define the nutritional requirements for selected known oil producing microalgae originally from marine and inland saline habitats. Species tested were SERI collections of Ankistrodesmus falcatus, Boekelovia sp., Chaetoceros gracilis, Chaetoceros SS-14, Cyclotella sp., Nannochloropsis (Nanno-Q) sp. and Platymonas sp. A protocol for culturing and quantifying growth as doublings/day was established using culture tubes on shakers. Culture tubes served as spectrophotometric cuvettes and were read every 24 hours over a 5 day period. Nitrogen as NO_3, NH_4 and urea were tested for preference and optimal concentrations. Phosphate-P, Si (for diatoms) and the trace metal Fe were also tested for optimal concentrations. The vitamins B_{12} and thiamine were found to be significantly important in the growth of three of the species. Nitrate was observed to be the best nitrogen source in three of the seven algae tested. Ammonia and urea-N were shown to be significantly preferred nitrogen sources for two species. Iron as $FeNH_4$-citrate significantly increased the growth of two of three species tested as compared to $FeCl_3$ additions. This information will hopefully be helpful to the SERI Aquatic Species Program as well as others as a guide toward optimizing growth prior to the shift toward lipid production.

1893 (SERI/SP—231-3071, pp 250) **Environmental control of lipid production in diatom cultures.** Barclay, W.; Chelf, P.; Nagle, N. Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Nutritional stress (either nitrogen or silica) has been shown to be an effective inducer of algal lipid production. Exploitation of this induction effect could be vital in their effort to reach program goals of 15% photosynthetic efficiency and 50% of dry weight as lipid. To this end, an understanding of how nutrient stress increases lipid production and how environmental factors affect this induction is essential. Some environmental factors with the potential to affect lipid production under nutrient stress are inorganic carbon supply (CO_3, bicarbonate), pH, light intensity, and temperature. Preliminary experiments suggested that increasing bicarbonate concentration resulted in higher lipid yields under both nitrogen and silica stresses in Navicula sp. The preliminary experiments designed to examine this effect yielded interesting results but have not unequivocally answered the question of whether a bicarbonate effect exists. Based on this initial data, alternative experimental approaches are proposed to approach this question.

1894 (SERI/SP—231-3071, pp 251) **Effects of light intensity on lipid production.** Nagle, N.; Barclay, B. Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Several conflicting reports have appeared in the literature, and in Aquatic Species Program research, on the effects of light intensity on lipid yield in microalgae. Some reports have suggested that high light intensity enhances lipid production while others have suggested that low light intensity improves lipid yield. The authors developed a simple procedure to evaluate light intensity effects on lipid induction in microalgae. A rotary screening apparatus was modified with neutral density filters to provide a variety of light intensities, from 100-1000 $\mu E\ m^{-2}\ sec^{-1}$. Additionally, a simple fluorometric procedure, utilizing nile red, was developed to quantify lipid yield. The data from several experiments suggest that higher light intensities, during stress induced lipid production, results in higher lipid yields in microalgae.

1895 (SERI/SP—231-3071, pp 252) **Flow cytometry techniques for species improvement.** Solomon, J.A. (Oak Ridge National Lab., TN). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW. Contract AC05-84OR21400.

In FY 1986 aquatic species program: Annual report.

Lipid accumulation in three species of microalgae was investigated using flow cytometry (FCM) and transmission electron microscopy (TEM). Previous studies using batch cultures of algae have led to the assumption that lipid accumulation in microalgae is a gradual process requiring at least several days for completion. However, FCM reveals, through changes in the chlorophyll:lipid ratio, that the short time span required for individual cells to change metabolic state is short. Simultaneous FCM measurements of chlorophyll and nile red (neutral lipid) fluorescence in individual cells of nitrogen-deficient Isochrysis populations revealed a bimodal population distribution as one stage in the lipid accumulation process. The fact that two discrete populations exist, with few cells in an intermediate stage, suggests rapid response to a lipid trigger. Interpretations of light and electron microscopic observations are consistent with this hypothesis. The time required for an entire population to achieve maximum lipid content is considerably longer than that required for a single cell, due to the variation in response time among cells. In this study, high lipid cultures were sometimes obtained by using FCM to separate high lipid cells from the remainder of the population. FCM holds much promise for strain enhancement but considerable developmental work, directed at providing more consistent results, remains to be done.

1896 (SERI/SP—231-3071, pp 253) **Biochemical elucidation of neutral lipid synthesis in microalgae.** Guckert, J.B.; Cooksey, K.E. (Montana State Univ., Bozeman). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

The pathways of lipid synthesis in all organisms examined so far are similar, but not identical. In general, all pathways involve the conversion of acetate to its Coenzyme A derivative condensation with bicarbonate and subsequent addition of C-2 units to form a 16 carbon fatty acid. Further chain lengthening involves acetyl CoA or Malonyl CoA. The point to stress is that the synthesis of all lipids involves 2 or 3 carbon fragments derived from acetate in its coenzyme A form. There are variations as to how acetyl CoA is synthesized and there has been considerable controversy as to where this process takes place. This research focuses on the pathway of synthesis of acetyl CoA and the further regulation of its metabolism. Acetyl CoA is at a branch point in metabolism, i.e., it can either be oxidized to 2 CO_2 and the CoA regenerated (TCA cycle) or it can condense with bicarbonate to form malonyl CoA and be committed to lipid synthesis. In some algae, nitrogen limitation fosters the second route. In some of diatoms, silicon limitation does the same thing, i.e., the inability of a cell to divide induces increased lipid synthesis to take place. They believe that feedback control on citrate synthase, the consumer of acetyl CoA for the TCA cycle by-oxoglutarate or ATP shuts off the cycle and acetyl CoA is converted to a lipid sink. How this control system can operate is discussed. Two organisms are studied initially; both are high lipid producers. They are a Chlorophyte, Chlorella sp. and a member of the Bacillariophyceae, Cyclotella. The Chlorella responds to nitrogen limitation, by synthesizing increased lipid whereas the diatom responds to Si limitation in the same way.

1897 (SERI/SP—231-3071, pp 255) **Biochemistry of neutral lipid synthesis in microalgae.** Coleman, L.; Rosen, B.; Schwartzbach, S. (Univ. of Nebraska, Lincoln). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Elucidation of the biochemical basis for enhanced lipid synthesis requires a reproducible method for inducing lipid synthesis. Since nitrogen deficiency rapidly reduces photosynthetic capacity, initial studies have therefore used Euglena, a microalgae which grows equally well under photosynthetic and heterotrophic conditions as a model system. Based on the results obtained with Euglena, attempts were made to induce lipid synthesis in Chlorella SO1 and Nannochloropsis saline. N-deficient Euglena utilize exogenous carbon for the net synthesis of both carbohydrates and lipids in the light and the dark. The lipid content of N-deficient cells is 2-5x higher than that of N-sufficient cells. Growth at 33 C rather than 26 C increases the cellular lipid content, but inhibits the synthesis of lipid by N-deficient cells. Chlorella SO1 grows well in the dark with glucose. Additional glucose to N-deficient cultures grown in the light on glucose failed to stimulate lipid synthesis. When Chlorella SO1 was grown photosynthetically to N-deficiency, cellular lipid content increased. The authors have been unable to maintain axenic cultures of Nannochloropsis salina. As cells entered N-deficiency, cellular lipid content and dry weight increased while chlorophyll decreased. The lipid content of N-deficient cells was at least twice that of N-sufficient cells. The addition of nitrogen to N-deficient cultures stimulated cell division and chlorophyll synthesis. Taken together, the results with Euglena and Nannochloropsis salina indicate that lipid accumulation in these algae can be reproducibly triggered by N-deficiency.

1898 (SERI/SP—231-3071, pp 257-272) **Biochemical aspects of lipid accumulation in silicon-deficient diatoms.** Roessler, P. Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Three different diatom species were examined with respect to lipid accumulation under silicon-deficient growth conditions. The lipid contents of Cylindrotheca fusiformis and Cyclotella cryptica cells increased significantly as a result of Si-deficiency, but this was not observed with Thalassiosira pseudonana. However, the neutral lipid content of all three species increased by at least two-fold under conditions of Si-limitation. Additional experiments indicated that the partitioning of newly assimilated carbon was rapidly and significantly altered in response to Si-deficiency in C. cryptica. The percentage of carbon partitioned into chrysolaminarin was reduced by 50%, while the fraction partitioned into lipid was nearly doubled. This was apparently due to differential amounts of decrease in the absolute rates of carbon assimilation into these two compounds. In order to better understand the biochemical basis of these changes in carbon partitioning, studies have been initiated which are designed to examine the regulation of key enzymes of carbon metabolism during the course of Si-deficiency. Preliminary results suggest that the first committed step in chrysolaminarin synthesis is catalyzed by UDP-glucose pyrophosphorylase. When assayed in cell-free extracts of C. cryptica, this enzyme had maximal activity at pH 7.8, and was greatly stimulated by Mg^{2+} and Mn^{2+}. Unlike the ADP-glucose pyrophosphorylases of green algae and higher plants that are involved in starch biosynthesis, the activity of UDP-glucose pyrophosphorylase is not strongly modulated by phosphate or 3-phosphoglycerate. 15 references, 7 figures, 2 tables.

1899 (SERI/SP—231-3071, pp 273-284) **Effects of induction strategies on Chaetoceros (SS-14) growth with emphasis on lipids.** Sriharan, S.; Bagga, D. (Selma Univ., AL). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

The diatoms were batch cultured in N-sufficient (NS) (600 μM) and N-deficient (ND) (300 μM) media and two different temperatures (20 C and 30 C) under continuous illumination. The biomass was harvested during the log phase and stationary phase in NS and ND treatments respectively. The Ash-free dry weight (AFDW) was measured. Total lipids were extracted from harvested cells by extracting twice with methanol followed by two additional extractions with chloroform-methanol (1:1 v/v). The crude lipids were separated into neutral and polar lipids by column chromatography on silicic acid column. The results show that the AFDW was 1.181 g/l and 0.862 g/l in NS and ND treatments respectively at 20 C, and 1.201 g/l and 0.923 g/l at 30 C. The total lipids were respectively 0.198 g and 0.329 g of g AFDW in NS and ND; 0.196 g and 0.338 g of g AFDW at 20 C and 30 C. The neutral lipids were 0.122 g and 0.175 g of g AFDW in NS and ND; 0.137 g and 0.186 g of g AFDW at 20 C and 30 C respectively. The polar lipids were 0.031 g and 0.065 g of g AFDW in NS and ND; 0.057 g and 0.081 g of g AFDW at 20 C and 30 C respectively. The neutral lipids were 12.19% and 17.52% of AFDW in case of NS and ND treatments respectively at 20 C. At 30 C the neutral lipids were 13.66% and 18.63% of AFDW in NS and ND respectively. The polar lipids were 3.13% and 6.50% of AFDW in NS and ND media respectively at 20 C. At 30 C the polar lipids were 5.75% and 8.13% of AFDW in NS and ND respectively. These observations show that by growing diatom Chaetoceros (SS-14) in nitrogen limited supply, the production of lipids, particularly neutral lipids, can be increased. 15 references, 2 figures, 4 tables.

1900 (SERI/SP—231-3071, pp 285-300) **Effects of fluctuating environments on the selection of high yielding microalgae.** Benemann, J.R.; Tillett, D.M. (Georgia Institute of Technology, Atlanta, GA). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

The production of lipids using microalgae requires that high lipid content algal strains be cultivated at high productivity under conditions which prevent other strains from dominating the cultures. What is not yet understood is whether dominance in outdoor systems is a property restricted to a few algal strains or whether a relatively diverse number of strains can dominate under similar outdoor pond conditions. In the development of such information it would be useful to use laboratory culture systems which simulate, as closely as possible, the outdoor pond environment. Such systems could be used to both screen algal species for their relative competitive abilities as well as to establish which specific factors (temperature, pCO_2, pO_2, growth rates, etc.) are responsible for their dominance. The requirements for culture dominance coupled to high lipid productivity could be met in principle by several approaches: (1) screening for relatively high lipid containing algae that are also dominant in ponds, (2) continuous exposure of the cultures to an environmental stress (e.g., limited nitrogen) that would increase lipid content without proportionately decreasing productivity, or (3) by temporal separation of biomass production from lipid production. The latter approach is the one followed by this project. It is based on the premise that transient metabolic capacities for secondary metabolism can exceed those achievable in steady state. This premise must still be proven for the case of lipid storage by microalgae. The authors describe below the development of a laboratory culture system capable of simulating the fluctuating pond environment and the preliminary species competition experiments carried out with this system. Also the results are described of a survey of eight species of microalgae for the induction of lipids by nitrogen starvation. 8 figures, 4 tables.

1901 (SERI/SP—231-3071, pp 301-320) **Temperature effects on microalgal photosynthetic efficiency.** Radmer, R.; Behrens, P. (Martek Corp., Columbia, MD). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Algal cultures grown in an outdoor production facility will experience daily and seasonal fluctuations in temperature, and thus these cultures will exist under less than ideal temperature conditions. As a result, it is important to determine the effect of changes in temperature on biomass productivity, since this information will be valuable in predicting the potential yield of algae grown in large-scale outdoor culture. The objectives of this project were to: (1) determine the maximum growth rate of selected algae under conditions in which neither nutrients, carbon dioxide, nor light were limiting, and (2) determine the effect of changes in temperature on biomass productivity and photosynthetic light efficiency. The maximum growth rates of Ankistrodesmus, Chaetoceros, Chlorella, Cyclotella, Navicula, Scenedesmus, and Skeletonema were determined to be 2.6, 4.6, 4.9, 3.9, 2.0, 3.3, and 2.0 doublings per day, respectively. The relationship of biomass productivity to cell concentration for a Scenedesmus continuous culture maintained at three different temperatures (18, 25, 32 C) and high light intensity (295-361 $\mu E/m^2/sec$) was determined. Biomass productivity was maximal at 25 C, and the relationship of productivity to cell concentration was temperature dependent (i.e. the cell concentration required to obtain maximum productivity changed significantly as a function of temperature). 2 references, 7 figures.

1902 (SERI/SP—231-3071, pp 321-336) **Genetic variation in oil-producing microalgae.** Gallagher, J.C. (City College of New York, NY). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Clones of Amphora coffaeformis and Nannochloropsis spp. were examined for genetic differences by gel electrophoresis. Strains of both types of organisms were found to be genetically variable. Clones of Amphora isolated over a series of sites with 300 m of each other showed greater genetic diversity than planktonic diatoms examined previously. There was no clear relationship between environmental factors and the frequency of different genotypes. Clones with similar frustule morphology were found to be more closely related to each other than those with different morphologies. The presence of a relatively high proportion of heterozygotes and the lack of linkage groups among alleles at different loci indicate that interbreeding among genotypes may be occurring in natural populations of Amphora. Clones of Nannochloropsis exhibited a wide range of genotypes in spite of having virtually identical morphology. 18 references, 4 figures, 3 tables.

1903 (SERI/SP—231-3071, pp 337) **Kelp genetics.** Neushul, M. (Neushul Mariculture Inc., Goleta, CA). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Work on giant kelp biomass production began at NMI in June, 1980 when the company began to install, plant, harvest, measure and analyze the results of an in-the-sea macroalgal farm. It was shown that the giant kelp was equivalent to sugar-cane in it's productivity under cultivation. The importance of genetic strain selection soon became apparent and a seed stock collection of pedigreed lines was established. Both intergeneric and interspecific hybrids of pacific coast kelps were produced. Current research at NMI focuses on the development of new techniques to genetically manipulate kelps. Progress has been made in bacteria-free culture, the control of gametogenesis, the measurement of ploidy levels, tetrad analysis and the use of mutagens. Since kelp gametophytes are long-lived, have no somoclonal variation, they can be used as a seed bank of genetic types. It seems logical to screen them under laboratory conditions, and retain those that yield kelp plants that produce specific products, or are particularly productive. Researchers have found that there is variability in the growth rates of gametophytes, but have not yet been able to link high gametophytic growth with high sporophytic growth. The problem of genetically domesticating macroalgae can be extended to other algal groups, where cultivation methods, DNA measurement methods, mutagenesis, transgenosis, and many other techniques are yet to be tried. The great advantages of exploiting the genetic diversity of the algae are not always evident. However some algae produce products that could be very valuable. Genetically domesticating such plants will certainly be of value to the SERI Aquatic Species Program.

1904 (SERI/SP—231-3071, pp 338) **Characterization of viruses infecting Chlorella-like alga.** Meints, R.H.; Schuster, A.M.; Van Etten, J.L. (Univ. of Nebraska, Lincoln). Feb 1987. NTIS MF A01. Order Number DE87001149/JAW.

In FY 1986 aquatic species program: Annual report.

Exsymbiotic, Chlorella-like, eukaryotic green algae act as hosts for a group of DNA containing viruses. The authors have isolated over 100 plaque forming viruses from fresh water collected from ponds, streams and rivers throughout the US. For this study 15 representative viruses from a single Nebraska water sample are being subjected to detailed analysis. Based on previous studies, the authors have described a prototype virus, PBCV-1, a large, dsDNA (330 kbp) virus which infects three exsymbiotic strains of Chlorella. PBCV-1 is easily assayed since it will form plaques on lawns of the alga. Viral attachment and infection is rapid and the entire lytic cycle of the virus is completed within 8 hrs. This is the only example of a plant-virus interaction which lends itself to manipulation using the technology established for study of bacteriophage. When the viruses ultimately lyse their algal hosts, the resulting lysate is a rich source of cell wall degrading enzyme(s), which the authors have called lysin. Treatment of cells with lysin results in the complete degradation of the algal wall, leading to the formation of protoplasts. The authors propose to use these protoplasts as useful partners in creation of somatic hybrids and as hosts for direct transformation with autonomously replicating vectors created from all or portions of the viral genomes. In general, conventional means for improvement of plant species revolve about the transfer, through conventional sexual hybridization, of desired genetic traits. For many microalgae, for which sexual mating systems have not been demonstrated, alternative methods such as those described here, for transfer of genetic traits are required.

1905 **Antigenic distinctiveness, heterogeneity, and relationships of Methanothrix spp.** Macario, A.J.L.; Conway, E.; de Macario, E.C. (New York State Dept. of Health, Albany). *Journal of Bacteriology;* **169**: No. 9, 4099-4103(Sep 1987). Contract FG02-84ER13197.

A detailed immunologic analysis of Methanothrix soehngenii Opfikon (the type species of the genus), Methanothrix sp. strain CALS-1, and Methanothrix concilii GP6 was performed. A variety of poly- and monoclonal antibody probes for a comprehensive panel of reference organisms were used to determine immunogenicity, antigenicity, and relationships. The three organisms are antigenically distinct but interrelated, forming an immunologically cohesive group, weakly related to methanosarcinae. A prominent features of the organisms was heterogeneity characterized by antigenic diversity and compartmentation, the latter particularly evident in M. soehngenii Opfikon, which was examined more thoroughly. The complexity of the antigenic profile of this strain and the heterogeneity of the group suggest a high degree of phenotypic diversification within the genus.

1906 **Methods for isolation of auxotrophic mutants of methanobacterium ivanovii and initial characterization of acetate auxotrophs.** Jain, M.K.; Zeikus, J.G. (Michigan State Univ., East Lansing). *Applied and Environmental Microbiology;* **53**: No. 6, 1387-1390(Jun 1987). Contract FG02-85ER13376.

To develop a biochemical genetic approach to understanding cell carbon synthesis or metabolic pathways in methanogens, Methanobacterium ivanovii was selected as a model organism for genetic manipulation studies. The organism displayed a colony size of 3 to 6 mm in less than 2 weeks and had a plating efficiency of about 90%, which made it suitable for replica plating. Mutagenesis and selection techniques were developed for selection of acetate auxotrophs. Chemical mutagenesis with ethyl methanesulfonate, followed by enrichment with bacitracin as a selective agent, resulted in stable acetate auxotrophs. M. ivanovii was very sensitive to UV, but UV-induced acetate auxotrophs were unstable and reverted within two to four transfers. The acetate auxotrophs were analyzed in relation to wild type for carbon monoxide dehydrogenase enzyme activity.

5509 Pathology

REFER ALSO TO CITATION(S) 1393, 1972

1907 **(PB—87-222105/XAB) Case-control study of respiratory cancer and employment.** Glazer, E.R.; Chiang, M.L. (California Dept. of Health Services, Emeryville (USA). Resource for Cancer Epidemiology Section). Apr 1984. 85p. NTIS, PC A05/MF A01.

A multiple logistic risk-analysis procedure was used to compare data from 346 case/control pairs to determine occupational/industrial risk factors for respiratory cancer. The duration of employment was considered in blue-collar production occupations. Five industrial categories were included: shipyard, petrochemical, metal-related, construction and a grouping of other occupations under a single heading. The bulk of this grouped category was made up of blue collar employees in the industries of transportation, food production, wholesale and retail trade, professional services, and public administration. Specific attention was given to asbestos exposure, cigarette smoking, educational level attained, and dietary factors such as consumption of vegetables, fruits, and alcohol. A moderately elevated risk for respiratory cancer existed among employees in the metal industry and grouped categories when employment was over 30 years duration. In the metal industry this increase was almost entirely due to a larger than expected number of cases of larynx cancer.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 1849, 1922, 1990

1908 **(LA-UR—87-2747) Dimensional analysis of heart rate variability in heart transplant recipients.** Zbilut, J.P.; Mayer-Kress, G.; Geist, K. (Rush Univ., Chicago, IL (USA). Graduate Coll. of Nursing; California Univ., Los Angeles (USA). Crump Inst. for Medical Engineering; Goettingen Univ. (Germany, F.R.). 3. Physikalisches Inst.). 1987. Contract W-7405-ENG-36. 36p. (CONF-8705193—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014773/JAW.

From CNLS workshop on nonlinearity in biology and medicine; Los Alamos, NM, USA (18 May 1987).

We discuss periodicities in the heart rate in normal and transplanted hearts. We then consider the possibility of dimensional analysis of these periodicities in transplanted hearts and problems associated with the record.

1909 **Biosynthetic nature of poly(γ-glutamylcysteinyl)glycines.** Anderson, P.; Jackson, P.; Robinson, N. (Los Alamos National Lab., NM). *Plant Physiology, Supplement;* **83**: No. 4, 144(Aug 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

Poly(Σglutamylcysteinyl)glycines, (γEC)/sub n/G, appear to be functional analogues of metallothionein in some plants. The presence of γ-carboxyamide linkages suggests that these compounds are not directly encoded by structural genes. This is confirmed by evidence that synthetic oligonucleotides which correspond to sequences which could encode such a polypeptide sequence, do not hybridize to mRNA isolated from cells which produce (γEC) G. When cells are grown in the presence of a pulse of [^{35}S] cysteine, and then exposed to unlabeled cysteine, radioactivity incorporated into $(\gamma EC)_2$ G is seen to migrate into longer chain forms. It appears that $(\gamma EC)_2G$ is a substrate for the synthesis of $(\gamma EC)_3G$, and $(\gamma EC)_3G$ is a substrate for the synthesis of longer polypeptides. Synthesis of (γEC)/sub n/ G is detected 5 min after exposure of cells to cadmium. This rapid response suggests that this biosynthetic pathway may initially be regulated at a post-transcription level, possibly due to product removal with the formation of (γEC)/sub n/ G-cadmium aggregates. Such a response suggests that (γED)/sub n/ G must be produced for some other purpose in addition to metal detoxification. One possibility is that these compounds act as the sulfur carrier molecule between adenylyl sulfate and cysteine in sulfate reduction.

1910 **Identification of tris(γglutamylcysteinyl)glycines in copper-tolerant mimulus guttatus roots.** Robinson, N.; Anderson, P.; Jackson, P. (Los Alamos National Lab., NM). *Plant Physiology, Supplement;* **83**: No. 4, 158(Aug 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

Copper-tolerant and non-tolerant M. guttatus plants synthesize a cysteine rich copper-complex following exposure to copper. Differences in the amount of this compound in the roots of tolerant and non-tolerant plants indicate that it may be involved in the mechanism of copper tolerance. Partial characterization suggested that this complex was metallothionein (MT)-like, but the structure was not fully elucidated. Poly(γglutamylcysteinyl)glycines, (γEC)/sub n/G, have been isolated and characterized from cadmium resistant Datura innoxia cells. These compounds bind metal ions, their synthesis is induced by metals and they appear to act as functional analogues of metallothionein. (γEC)/sub n/G from cadmium resistant D. innoxia cells was used to calibrate reverse phase HPLC columns (Hi-Pore RP-318, BioRad). Extracts prepared from the roots of M. guttatus plants, grown in the presence of [^{35}S] cysteine, were passed through Centricon 30 (Amicon Corp.) columns and then analyzed by reverse phase HPLC. $(\gamma EC)_3G$ was detected in extracts from plants grown in the presence of 10 μM copper for 48 h, but was not apparent in extracts from plants grown in the absence of this metal. It is not known whether the previously isolated putative MT is synonymous with $(\gamma EC)_3G$.

1911 **Effects of reduced amounts of lipid unsaturation on chloroplast ultrastructure and photosynthesis in a mutant of Arabidopsis.** McCourt, P.; Kunst, L.; Browse, J.; Somerville, C.R. (Michigan State Univ., East Lansing). *Plant Physiology;* **84**: No. 2, 353-360(Jun 1987). Contract AC02-76ER01338.

A mutant of Arabidopsis thaliana with reduced content of C/sub 18:3/ and C/sub 16:3/ fatty acids in membrane lipids exhibited a 45% reduction in the cross-sectional area of chloroplasts and had a decrease of similar magnitude in the amount of chloroplast lamellar membranes. The reduction in chloroplast size was partially compensated by a 45% increase in the number of chloroplasts per cell in the mutant. When expressed on a chlorophyll basis the rates of CO_2-fixation and photosynthetic electron transport were not affected by these changes. Fluorescence polarization measurements indicated that the fluidity of the thylakoid membranes was not significantly altered by the mutation. Similarly, on the basis of temperature-induced fluorescence yield enhancement measurements, there was no significant effect on the thermal stability of chlorophyll-protein complexes in the mutant. These observations suggest that the high content of trienoic fatty acids in chloroplast lipids may be an important factor regulating organelle biogenesis but is not required to support normal levels of the photosynthetic activities associated with the thylakoid membranes.

1912 **Total lipid production of the green alga Nannochloropsis sp. QII under different nitrogen regimes.** Suen, Yu.; Hubbard, J.S.; Holzer, G.; Tornabene, T.G. (Georgia Institute of Technology, Atlanta). *Journal of Phycology;* **23**: No. 2, 289-296(Jun 1987).

The green alga Nannochloropsis sp. QII was cultivated in media with sufficient and growth-limiting levels of nitrogen (nitrate). Nitrogen deficiency promoted lipid synthesis yielding cells with lipids comprising 55% of the biomass. The major lipids were triacylglycerols (79%), polar lipids (9%) and hydrocarbons (2.5%). The polar lipids consisted of a broad range of phospholipids, glycolipids and sulfolipids. Other lipids identified were pigments, free fatty acids, saponifiable and unsaponifiable sterol derivatives, various glycerides, a family of alkyl-1, 4-dioxane derivatives and a series of alkyl- and hydroxy-alkyl-dimethyl-acetals. Experiments in which $^{14}CO_2$ was provided at different times in the growth cycle demonstrated that enhanced lipid biosynthesis at low nitrogen levels resulted principally from de novo CO_2 fixation.

1913 **Red light-dependent CO_2 uptake and oxygen evolution in guard cell protoplasts of Vicia faba L.: evidence for photosynthetic CO_2 fixation.** Shimazaki, K.I.; Zeiger, E. (Stanford Univ., CA). *Plant Physiology;* **84**: No. 1, 7-9(May 1987). Contract AS03-81ER10924.

Suspensions of dark-adapted guard cell protoplasts of Vicia faba L. alkalinized their medium in response to irradiation with red light. The alkalinization peaked within about 30 minutes and reached steady state shortly thereafter. Simultaneous measurements of O_2 concentrations and medium pH showed that oxygen evolved in parallel with the red light-induced alkalinization. When the protoplasts were returned to darkness, they acidified their medium and consumed oxygen. Both oxygen evolution and medium alkalinization were inhibited by 3-(3,4-dichlorophenyl)-1,1-dimethylurea (DCMU). In photosynthetically competent preparations, light-dependent medium alkalinization is diagnostic for photosynthetic carbon fixation, indicating that guard cell chloroplasts have that capacity. The striking contrast between the responses of guard cell protoplasts to red light, which induces alkalinization, and that to blue light, which activates proton extrusion, suggests that proton pumping and photosynthesis in guard cells are regulated by light quality.

1914 **Proton gradients in intact cyanobacteria.** Belkin, S.; Mehlhorn, R.J.; Packer, L. (Lawrence Berkeley Lab., CA). *Plant Physiology;* **84**: No. 1, 25-30(May 1987). Contract AS03-80ER10637;AC03-76SF00098.

The internal pH values of two unicellular cyanobacterial strains were determined with electron spin resonance probes, over an external pH range of 6 to 9, in the light and in the dark. The slow growing, thylakoid-lacking Gloeobacter violaceus was found to have a low capacity for maintaining a constant internal pH. The distribution pattern of weak acid and amine nitroxide spin probes across the cell membranes of this organism, in the light and in the dark, was consistent with the assumption that it contains a single intercellular compartment. At an external pH of 7.0, intracellular pH was 6.8 in the dark and 7.2 in the light. The cells of Agmenellum quadruplicatum, a marine species, were found to contain two separate compartments; in the dark, the pH of the cytoplasmic and the intrathylakoid spaces were calculated to be 7.2 and 5.5, respectively. Upon illumination, the former increased and the latter decreased by about 0.5 pH units.

1915 **Developmental regulation of β-conglycinin in soybean axes and cotyledons.** Ladin, B.F.; Tierney, M.L.; Meinke, D.W.; Hosangadi, P.; Veith, M.; Beachy, R.N. (Washington Univ., St. Louis, MO). *Plant Physiology;* **84**: No. 1, 35-41(May 1987). Contract AC02-81ER10888.

Analysis of the expression of genes encoding the β-conglycinin seed storage proteins in soybean has been used to extend the authors understanding of developmental gene expression in plants. The α,α′, and β subunits of β-conglycinin are encoded by a multi-

gene family which is organ-specific in its expression. In this study the authors report the differentially programmed accumulation of the α,α', and β subunits of β-conglycinin. Multiple isomeric forms of each subunit are present in the dry seed, but the timing of their accumulation is unique for each subunit. The previously reported variation in amount of α' and α subunits in axis and cotyledons is also reflected in the amount of subunit specific mRNA which is present in each tissue. The β subunit, previously undetected in soybean axes, is found to be synthesized but rapidly degraded. These differences in β-conglycinin protein accumulation may be reflected by the morphological differences observed in protein bodies between these two tissues.

1916 **Anapleurotic CO_2 fixation by phosphoenolpyruvate carboxylase in C_3 plants.** Melzer, E.; O'Leary, M.H. (Univ. of Wisconsin, Madison). *Plant Physiology;* 84: No. 1, 58-60(May 1987). Contract AC02-83ER13076;FG02-86ER13534.

The role of phosphoenolpyruvate carboxylase in photosynthesis in the C_3 plant Nicotiana tabacum has been probed by measurement of the ^{13}C content of various materials. Whole leaf and purified ribulose bisphosphate carboxylase are within the range expected for C_3 plants. Aspartic acid purified following acid hydrolysis of this ribulose bisphosphate carboxylase is enriched in ^{13}C compared to whole protein. Carbons 1-3 of this aspratic acid are in the normal C_3 range, but carbon-4 (obtained by treatment of the aspartic acid with aspartate β-decarboxylase) has an isotopic composition in the range expected for products of C_4 photosynthesis (-5%), and it appears that more than half of the aspartic acid is synthesized by phosphoenolpyruvate carboxylase using atmospheric CO_2/HCO_3^-. Thus, a primary role of phosphoenolpyruvate carboxylase in C_3 plants appears to be the anapleurotic synthesis of four-carbon acids.

1917 **Inhibition and labeling of the plant plasma membrane H^+-ATPase with N-ethylmaleimide.** Katz, D.B.; Sussman, M.R. (Univ. of Wisconsin, Madison). *Plant Physiology;* 83: No. 4, 977-981(Apr 1987). Contract AC02-83ER13086.

H^+-ATPase activity in plasma membranes isolated from Avena sativa root cells is inhibited by N-ethylmaleimide, a covalent modifier of protein sulfhydryl groups. The rate of inhibition is reduced by ADP, MgADP, and MgATP, but even at 40 millimolar ADP the enzyme is only partially protected against inactivation. When plasma membranes are treated with N-[2-^{3}H]ethylmaleimide and analyzed by sodium dodecyl sulfate polyaerylamide gel electrophoresis, prominent radioactive bands appear at M/sub r/ = 100,000 and several other positions. However, only radioactivity in the M/sub r/ = 100,000 protein is reduced by the presence of MgADP. These results provide independent evidence that the M/sub r/ = 100,000 polypeptide which is observed in purified preparations of the enzyme is the catalytic subunit of the H^+-ATPase. When tryptic peptides are produced from N-[2-^{3}H]ethylmaleimide labeled M/sub r/ = 100,000 protein and separated by reverse phase high performance liquid chromatography, two radioactive peaks are observed for which N-[2-^{3}H]ethylmaleimide incorporation is reduced in the presence of MgADP.

5520 Public Health

REFER ALSO TO CITATION(S) 1729, 1736, 1737, 1907, 1977

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 1763, 1866

1918 **(INIS-BR—732) Detection of cardiac magnetic fields (magnetocardiography).** Ribeiro, P.C. (Associacao Brasileira de Fisicos em Medicina, Rio de Janeiro). 1985. 6p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703484/JAW.

A brief comment about the biological event of mechanical heart is presented. A comparative evaluation between electrocardiography and magnetocardiography is do done and this last method is described shortly. (M.A.C.).

1919 **(INIS-GB—91) Revolution in food preservation.** (Food and Drink Federation, London (UK)). 1986. 10p. Food and Drink Federation, 6 Catherine Street, London WC2B 5JJ.

A brief consumer guide to food irradiation is presented. Aspects covered include some of the advantages of food irradiation compared to other methods of food preservation, the type of radiation used, the mechanism of action, some practical applications, safety and future benefits.

1920 **(INIS-mf—10976) Studies on the control of fungal contamination and aflatoxin production by Aspergillus flavus link in a cereal grain by the combination treatment of heat and irradiation.** Odamtten, G.T. (Landbouwuniversiteit Wageningen (Netherlands)). 4 Nov 1986. 201p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE87703758/JAW.

Traditional storage of maize in tropical countries such as Ghana results in the rapid development of numerous fungi, including potential mycotoxin producers such as Aspergillus flavus (aflatoxins), A. ochraceus (ochratoxins, penicillic acid), Fusarium moniliforme (moniliformin), Paecilomyces varioti and Penicillium expansum (patulin). Treatment of maize with a combination of moist heat (30 min. at 60/sup 0/C and relative humidity > 85%) and gamma irradiation (4.0 kGy) proved to be effective in inactivating the resident population of fungal spores. This result was confirmed by in vitro studies with spores of Aspergillus flavus NRRL 5906. In a comparative study of packaging materials it was found that food commodities stored in woven polypropylene bags for six months at 85% R.H. had mould and yeast counts which were 2-3 log cycles lower than those of products kept in jute bags. Also, the viability of the seeds was better preserved in polypropylene sacks. It is recommended that the combination treatment be carried out on good quality grains, and that woven polypropylene sacks are used in packaging prior to irradiation, for maximum extension of shelf-life. (Auth.). Includes Dutch summary

1921 **(PNL—6311) Irradiation preservation of seafood: Literature review.** Molton, P.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001691/JAW.

The application of gamma-irradiation for extending the shelf life of seafood has been of interest for many years. This report reviews a number of studies on seafood irradiation conducted over the past several years. Topics covered include seafood irradiation techniques and dosages, species applicability and differences, the effects of packaging on seafood preservation, and changes in organoleptic acceptability as a result of irradiation. Particular attention is given to radiation effects (likely and unlikely) of concern to the public. These include the potential for generation of toxic chemical products, botulinum toxin production, and other health concerns. No scientifically defensible evidence of any kind was found for any harmful effect of irradiation of seafoods at the doses being considered (less than 300 krad), and all indications are that irradiation is an acceptable and needed additional tool for seafood preservation. 49 refs., 14 figs., 14 tabs.

1922 **Growth and yield of barley isopopulations differing in solute potential.** Grumet, R.; Albrechtsen, R.S.; Hanson, A.D. (Michigan State Univ., East Lansing). *Crop Science;* 27: No. 5, 991-995(Sep-Oct 1987). Contract AC02-76ER01338.

The active accumulation of solutes by osmotically stressed plants is thought to be an adaptive response that increases the ability of drought- or salt-stressed plants to maintain leaf water content, turgor, and possibly growth. In an earlier study the authors developed two barley (Hordeum vulgare L.) isopopulations differing in solute potential (Psi/sub s/), and these isopopulations were characterized for their response to salt stress in the growth chamber. At each stress level tested, the low-Psi/sub s/ population had about 0.1 MPa lower Psi/sub s/. In the present study the authors used these isopopulations to test the effect of genetic differences in Psi/sub s/ on growth in well-watered and drought-stressed conditions in the greenhouse and field. When grown in the greenhouse, the low-Psi/

sub s/ population had a slower rate of leaf production and accumulated significantly less total above ground dry matter by midanthesis than did the high-Psi/sub s/ population. This difference (up to 35%) was greatest in optimal environmental conditions (adequate water, high irradiance, warm temperature) and decreased in less favorable environments. The growth differences were not associated with differences in partitioning of dry matter to the leaves or differences in water use efficiency. The growth disadvantage of the low-Psi/sub s/ population was also observed for grain yield (11-44%) and total above ground biomass production (10-25%) under dryland and irrigated conditions in multisite field trials. Thus the development of a barley isopopulation with constitutively lower Psi/sub s/ resulted in a reduction in yield potential.

1923 **Self-thinning exponent correlated with allometric measures of plant geometry.** Weller, D.E. (Oak Ridge National Lab., TN). *Ecology;* 68: No. 4, 813-821(Aug 1987). Contract AC05-84OR21400.

The -3/2 power rule of self-thinning, which describes the course of growth and mortality in crowded, even-aged plant stands, predicts that average mass is related to plant density by a power equation with exponent -3/2. The rule is widely accepted as an empirical generalization and quantitative rule or law. Simple geometric models of space occupation by growing plants yield a power equation, but the exponent can differ from -3/2 when realistic assumptions about the allometric growth of plants are considered. Because such deviations conflict with the empirical evidence for the -3/2 value as a law-like constant, the geometric models have not produced an accepted explanation and the thinning rule remains poorly understood. Recent studies have concluded that thinning exponents can deviate more widely from -3/2 than previously thought, motivating the present re-evaluation of the geometric explanation. The authors extends the simple models to predict the relationships of the thinning exponent to allometric exponents derived from commonly measured stand dimensions, such as height, average mass, average bole diameter at breast height (DBH), and average bole basal area. If the form and exponent of the thinning equation arise from the geometry of space filling, then thinning exponents should be systematically related to the exponents of allometric equations relating average height to average mass, averaged height to average DBH, and average height to average basal area. He also predicts some values for the slopes and intercepts of regression lines relating thinning exponents to the allometric exponents.

1924 **Use of a secondary host by non-outbreak populations of the gypsy moth.** Rossiter, M. (State Univ. of New York, Stony Brook). *Ecology;* 68: No. 4, 857-868(Aug 1987).

Oaks are the favored host of gypsy moths in the northeastern US, although the herbivore expands its host range dramatically during an outbreak. Pitch pine, a secondary host because of its unacceptability for early development, was found to be frequently used for oviposition in oak-pitch pine forests with non-outbreak populations. This observation led to the study of ecological and behavioral factors that can contribute to the use of a secondary host under low-density conditions by an irruptive herbivore species. A series of manipulative field and laboratory experiments plus a study of natural history provided data on the pattern of pitch pine use during the life cycle of the gypsy moth, the effect of pitch pine on larval growth, and the differential impact of natural enemies depending on host use. It was found that: 1) egg masses occurred far more frequently on pitch pine than was expected based on the frequency of pitch pine in forests with low-density gypsy moth populations; 2) in the laboratory, early-instar larvae could not survive on pitch pine while late-instar larvae grew well; 3) in the field, larvae began to use pitch pine to feed and rest after the onset of the fourth instar. Compared to oak, 4) egg masses on pitch pine experienced less parasitism; 5) the microhabitat of pitch pine held less nuclear polyhedrosis virus (NPV), a major mortality agent of the gypsy moth; 6) individuals hatching from eggs laid on pitch pine were less infected with NPV; and 7) larvae dosed with a known amount of NPV survived longer when feeding on pitch pine foliage. The use of pitch pine by individuals in low-density gypsy moth populations appeared to be beneficial and may have an important effect on population dynamics. The mobility associated with host switching by late-instar larvae and with dispersal by first-instar larvae oviposited on unacceptable food may represent an important mechanism for host-range extension.

1925 **Dissipation of the membrane potential in susceptible corn mitochondria by the toxin of Helminthosporium maydis, race T, and toxin analogs.** Holden, M.J.; Sze, H. (Univ. of Maryland, College Park). *Plant Physiology;* 84: No. 3, 670-676(Jul 1987). Contract AS05-82ER13015;FG05-86ER13461.

The authors have tested directly the effect of Helminthosporium maydis T (Hmt) toxin and various analogs on the membrane potential formed in mitochondria isolated from a Texas (T) cytoplasmic male-sterile and a normal (N) corn. ATP, malate or succinate generated a membrane potential (negative inside) as monitored by the absorbance change of a cationic dye, safranine. The relative membrane potential (Δ psi) could also be detected indirectly as $^{45}Ca^{2+}$ uptake. Hmt toxin added to T mitochondria dissipated the steady state δ psi similar to addition of a protonophore, carbonyl cyanide m-chlorophenylhydrazone (CCCP). Toxin analogs (Cpd XIII: $C_{41}H_{68}O_{12}$ and Cpd IV: $C_{28}H_{44}O_8$), reduced native toxin (RT2C: $C_{41}H_{64}O_{13}$) and Pm toxin (band A: $C_{82}H_{60}O_{28}$, produced by the fungus, Phyllosticta maydis) were effective in dissipating Δ psi and decreasing Ca^{2+} uptake with the following order: Pm (100) >> HmT (23-30) > Cpd XIII (11-25) >> RT2C (0.4-1.8) > Cpd IV (0.2-1.0). In contrast, the toxins and analogs had no effect on δ psi formed in N mitochondria. The striking similarities of the HmT toxin (band 1: $C_{41}H_{68}O_{13}$) and Cpd XIII on T mitochondrial activities provide strong evidence supporting the correctneas of the polyketol structure assigned to the native toxin. Since the Δ psi in energized mitochondria is caused mainly by the electrogenic extrusion of H^+, the results support the idea that HmT toxin increases membrane permeability of T mitochondria to H^+. The host specificity of the toxin suggests that an interaction with unique target site(s) on the inner mitochondrial membrane of T corn causes H^+ leakage.

1926 **Solubility characteristics of residual phosphate in a fertilized and limed ultisol.** Harrison, R.B.; Adams, F. (Auburn Univ., AL). *Soil Science Society of America Journal;* 51: No. 4, 963-969(Jul-Aug 1987). Contract AC05-84OR21400.

Except at very low P rates, residual soil P (i.e., that measured by most extraction methods) continues to increase with annual additions of P fertilizer. Phosphorus retention mechanisms, however, are still much debated and difficult to prove or disprove. In an effort to determine whether the solubility of phosphate minerals controlled soil-solution P concentration in the field under some conditions, samples of a Benndale sandy loam were collected from plots of a field experiment with different pH and P levels and analyzed in the laboratory. Several soil pH levels were first established (5.0-8.0); this was followed by annual additions for 7 yr of concentrated superphosphate at five rates varying from 0 to 392 kg P ha^{-1} yr^{-1} and cropping annually. Soil-solution composition was determined in samples taken 1, 3, and 5 yr after discontinuing P fertilization. Except for the no P treatment, solution P increased with increasing pH up to pH 5.8, then it decreased as pH increased, suggesting the accumulation of a basic phosphate mineral such as hydroxyapatite at about pH 5.8 and above. However, this was not matched by the ion activity product (IAP) for $Ca_5OH(PO_4)_3$ or any other P mineral. Thus, IAP's could not be used to predict that solid-phase minerals were or were not controlling solution P. Sequential equilibration of selected soil samples with 0.01 M $MgCl_2$, however, provided data that strongly supports the hypothesis that hydroxyapatite was present in a high P, high pH soil but not in a low P, high pH or a high P, low pH soil.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 1197

1927 **(AD-A—183232/8/XAB) Effect of ionizing radiation on prostaglandins and gastric secretion in rhesus monkeys.** Dubois, A.; Dorval, E.D.; Steel, L.; Fiala, N.P.; Conklin, J.J. (Uniformed Services Univ. of the Health Sciences, Bethesda, MD (USA). Dept. of Medicine). 1985. 17p. NTIS, PC A02/MF A01.

The radiation induced prodromal syndrome is characterized by nausea and vomiting. Gastric emptying, gastric motility, and gastric secretion were suppressed after total-body exposure to irradiation. The relation between vomiting and gastric function is evaluated, and the possible role of prostaglandins (PG) in these phenomena is explored. The concentration of PG in the plasma and gastric juice was determined using standard radioimmunoassay and gastric-acid output was concurrently measured using a marker dilution techniques in 9 rhesus monkeys. The animals were studied in the basal state and after total-body exposure to 800 cGy ^{60}Co delivered at a rate of 500 cGy/min. Acid output was abolished from 40 min to 2 hrs after irradiation but had returned to preirradiation levels 2 days later. Plasma PGE2 and PGI2 were not significantly modified by irradiation. In contrast, irradiation produced an immediate increase ($p<0.05$) in gastric-juice concentration of PGE2 and PGI2; both had returned to basal levels 2 days later. Thus, both PGE2 and PGI2 may be responsible for the immediate suppression of acid output. Observations suggest that measurement of PG concentration in the gastric juice is useful to examine the role of prostaglandins in gastric function.

1928 **(AD-A—183268/2/XAB) Selenium pretreatment enhances the radioprotective effect and reduces the lethal toxicity of WR-2721.** Weiss, J.F.; Hoover, R.L.; Kumar, K.S. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1987. 7p. (AFRRI-SR—87-22). NTIS, PC A02/MF A01.

Pub. in Free Rad. Res. Comms., Vol. 3, No. 1-5, 33-38(1987).

Although WR-2721, S-2-(3-aminopropylamino) ethylphosphorothioic acid, is an effective radioprotector, its use is limited by its toxicity. Combining WR-2721 with other agents might decrease its toxicity and/or increase its effectiveness. The effect of selenium (Se) pretreatment on the acute toxicity and radioprotective effect of WR-2721 was studied in male CD2F1 mice. Injection of 1.6 mg/kg Se 24 hr before WR-2721 (800-1200 mg/kg, IP) decreased the lethality of WR-2721 significantly. Lower doses of Se were also effective, but simultaneous administration was not effective. Se injection alone (1.6 mg/kg) 24 hr before cobalt-60 irradiation increased the survival significantly. A synergistic effect on post-rirradiation survival was observed when Se was injected 24 hr before WR-2721. Alkaline phosphatase activity in bone marrow cells and serum was significantly depressed after treatment with 1.6 mg/kg Se, suggesting that a retardation of conversion of WR-2721 to its active free sulfhydryl form through the action of alkaline phosphatase might be partly responsible for the effects of Se. Other possible mechanisms related to the antioxidant properties of Se are under investigation.

1929 **(AD-A—183314/4/XAB) Characterization of rat prothymocyte with monoclonal antibodies recognizing rat lymphocyte membrane antigenic determinants.** Hale, M.L.; Greiner, D.L.; McCarthy, K.F. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1987. 14p. (AFRRI-SR—87-11). NTIS, PC A02/MF A01.

Pub. in Cellular Immunology, Vol. 107, 188-200(1987).

Utilizing the technique of fluorescence-activated cell sorting and monoclonal antibodies directed at rat membrane antigens, various subpopulations of Lewis bone marrow cells were isolated and subsequently transfused into sublethally irradiated, histocompatible NBr recipient rats by either intravenous of intrathymic inoculation. Recipient rats were sacrificed and cell suspensions from thymus and other lymphoid tissue were examined for the presence of the RT7.1 marker on Lewis thymus-derived lymphocytes by fluorescence-activated cell analysis. From these studies, the population of Lewis bone-marrow cells that could resonstitute T cells in the NBr rats was found to be Ox-22 negative, Ox-7 positive, W3/13 positive, and Ox-18 positive. Further analysis characterized the prothymocyte as being Ox-7 upper 20% positive and W3/13 weakly positive. In addition, this marrow-cell population was able to protect lethally irradiated Lewis rats (9.5 GY) in 30-day survival tests. These studies have indicated that the prothymocyte either has been derived from the Ox-22 negative, Ox-7 upper 20% positive, and W3/13 positive marrow cells or, like the hematopoietic stem cell, this cell has also been characterized by this phenotype.

1930 **(AD-A—183339/1/XAB) Protection of mice against fission-neutron irradiation by WR-2721 or WR-151327.** Steel, L.K.; Jacobs, A.J.; Giambarresi, L.I.; Jackson, W.E. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1987. 11p. (AFRRI-SR—87-19). NTIS, PC A02/MF A01.

Pub. in Radiation Research, Vol. 109, 469-478(1987).

Two phosphorothioate compounds, WR-2721 and WR-151327, were examined for their radioprotective efficacies against the effects of fission-neutron irradiation in male and female mice. Within sex groups no significant difference in lethality at 30 or 100 days postirradiation was found between WR-2721 or WR-151327 pretreatment. The dose-modification factors (DMFs) for male mice treated with either compound were 1.29 (LD50/30) and 1.24 (LD50/100), and those for drug-treated female mice were 1.21 (LD50/30) and 1.19 (LD50/100). Both WR-2721 and WR-151327 were found to be equally radioprotective when compared using DMFs as the end point. WR-151327 were found to be equally radioprotective when compared using DMFs as the end point. WR-151327 (500 mg/kg, ip) was found to be significantly more toxic to both male and female B6D2F1 mice than equimolar amounts of WR-2721. Small but significant sex differences in radioprotection were found: the DMFs for female mice pretreated with either compound were lower than those for similarly treated male mice; the incidence of mortality 31-100 days postexposure in male mice pretreated with WR-151327 was greater than for female mice. In addition, sex differences were noted in drug toxicity. Toxic death in female mice given WR-151327 (500 mg/kg, ip) is 2.6 times more probable than in males.

1931 **(GSI—87-23-Prepr.) Heavy ion radiobiology and therapy: Present situation and possible future developments at GSI.** Kraft, G.; Kraft-Weyrather, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). May 1987. 13p. NTIS, PC E07; NTIS as TIB/B87-11345.

Heavy ion beams exhibit a favourable depth dose distribution for tumor therapy compared to conventional radiation like γ- or X-rays. For ion beams less heavy than carbon, a low dose is deposited in the entrance channel which can be compared in the relative biological effectiveness (RBE) to sparsely ionizing radiation. Towards the end of the particle track, the energy deposition increases and a high dose is deposited by each single particle. Therefore, at the end of the range of the ion beam a high total dose combined with a high biological effectiveness is available for tumor therapy. The biological reaction mechanism in the regime of elevated efficiency ($RBE>1$) is not fully understood and a field of intense research activity at various heavy ion accelerators as for instance at Berkeley, Darmstadt and recently at Caen. A brief summary of the Darmstadt radiobiology program and, in addition, a short outline of the new heavy ion synchrotron, presently under construction at GSI will be given. This heavy ion synchrotron is capable to accelerate all ions from helium to uranium up to energies of 1 GeV/u with intensities of 10/sup 9/-10/sup 11/ particles/sec. It is intended to use this machine mainly for basic research in atomic, nuclear and bio-physics. However, it should be possible to use this machine in a time sharing mode for therapeutical applications too, without a major set back for the physics experiment.

1932 **(INIS-BR—585) Proceedings of the 20. Brazilian Congress of Radiology; 4. Brazilian Congress of Ultrasonography; 2. Latin American Congress of Ultrasonography; 1. Brazilian Congress of Physicists in Medicine.** (FURNAS, Rio de Janeiro (Brazil)). 1985. vp. (CONF-8409378—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780098/JAW.

From 14. All-Union conference on roentgen and electronic spectroscopy; Irkutsk, USSR (1 Sep 1984).

A proceedings on medical radiology is presented. Ninety-three papers have been indexed for the Energy Data Base.

1933 **(INIS-BR—733) Acute radiation syndrome.** Souhami Filho, L. (Associacao Brasileira de Fisicos em Medicina, Rio de Janeiro). 1985. 11p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703485/JAW.

Symptoms and signs from medical aspects resulting from whole body exposure, or in the main part, to ionizing radiation are described. The dose-response relationship is studied and the exposure is divided in three parts: central nervous system syndrome, gastrointestinal syndrome and hematopoietic syndrome. Brief comments about the treatment are reported. (M.A.C.).

1934 **(INIS-mf—10960) Protection in handling ionizing radiation sources in national economy. Collection of study texts.** (Ceskoslovenska Komise pro Atomovou Energii, Prague; Ceskoslovenska Vedeckotechnicka Spolecnost, Ostrava. Dum Techniky). 1986. 148p. (In Czech). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703557/JAW.

The collection of study texts is divided into 13 chapters giving an explanation of the structure of the atom, the properties of ionizing radiation and its interactions, quantities and units used, basic dosimetric methods, biological radiation effects, the sources of population exposure, the principles of radiation protection, technological applications of ionizing radiation, the monitoring of personnel and environment, the method of recording and filing, the method of protection from external radiation and internal contamination, health care, and requirements for protection in handling nonsealed sources. (M.D.).

1935 **(ISH—95) Comparative investigations of the cesium and potassium metabolism in the mammal organism, with particular regard to discrimination effects.** Burkhardt, J.; Wirth, E. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Sep 1986. 77p. (In German). Bundesgesundheitsamt, Neuherberg, Germany, F.R. Inst. fuer Strahlenhygiene.

Differences in the distribution of the two homologues between various organs is due to different affinities of organ specific cell membranes for cesium and potassium. The degree of cell type and organ-specific discrimination between the two alkali metals during resorption in the gastrointestrial tract, organ distribution and excretion can easily be quantified. The different affinities for the two alkali metals observed in cell membrane transport mechanisms is responsible for the marked discrimination of cesium by erythrocytes and its preferential concentration in red muscle fiber cells. With respect to excretion there is no apparent difference between the two metals. Physiokinetically it is possible to explain why, in spite of homologous behaviour of potassium and cesium within an organism, an increased potassium intake does hardly or not at all influence cesium excretion. Finally the 'observed ratio' of the antagonists cesium and potassium for varius mammalian cell types and organs is quantified. The 'observed ratio' for the total body is the arithmetic mean for all organ-specific discrimination factors, taking into account the contribution of individual organs to the weight of whole body. The comparative investigation of the metabolic behaviour of both alkali metals shows, that the combined analysis of cesium and potassium is not only justifiable, but also necessary owing to their identical metabolic pathways, because the cesium regulation via the potassium metabolism is accounted for.

1936 **(N—87-25705) Morphometrics of cellular damage in mice testis receiving x-ray and high-energy particle irradiation. Final technical report.** Sapp, W.J. (Tuskegee Inst., AL (USA)). Jun 1987. 27p. (NASA-CR—180994; NAS—1.26:180994). NTIS, PC A03/MF A01.

Murine testes were exposed to single, low doses of either x-ray, helium, or argon radiation. Animals were sacrificed seventy-two hours later. Testes were fixed for transmission electron microscopy (TEM) and sectioned at either 60 nm for TEM observation or at 2 micron for counting using routine light microscope methods. Counts of the total population of surviving spermatogonia, including all type A cells, intermediate, and type B cells, were taken from tubule cross sections identified as Stage 6 and Stage 1 according to spermatogonial configuration. The surviving fraction of spermatogonia as compared to control, S/S sub o, was calculated for each dose. For both ions and x rays, there was a rapid decline in survival at dose levels of .10 to .15 Gy in Stage 6 tubules. This was followed by a more gradual decrease in population. At higher doses, 0.30 Gy for argon and 0.80 Gy for helium and x rays, the cell survival rates declined rapidly. Pre-leptotene spermatocytes in Stage 1 tubules exhibited a different survival curve indicating the extreme radiosensitivity of type B spermatogonia. Data verify that the seminiferous tubules are composed of a heterogeneous population of cells with different radio-sensitivities and that these differences are manifested even at very low doses.

1937 (N—87-25884, pp 10) **Evaluation of an automated karyotyping system for chromosome aberration analysis.** Prichard, H.M. Jun 1987. NTIS, PC A13/MF A01. (NASA-CR—171984-VOL-2; NAS—1.26:171984-VOL-2).

In National Aeronautics and Space Administration (NASA)/ American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, Volume 2.

Chromosome aberration analysis is a promising complement to conventional radiation dosimetry, particularly in the complex radiation fields encountered in the space environment. The capabilities of a recently developed automated karyotyping system were evaluated both to determine current capabilities and limitations and to suggest areas where future development should be emphasized. Cells exposed to radiometric chemicals and to photon and particulate radiation were evaluated by manual inspection and by automated karyotyping. It was demonstrated that the evaluated programs were appropriate for image digitization, storage, and transmission. However, automated and semi-automated scoring techniques must be advanced significantly if in-flight chromosome aberration analysis is to be practical. A degree of artificial intelligence may be necessary to realize this goal.

1938 **(NIRS-M—54) Proceedings of the 15th NIRS symposium on radiation-induced genetic damage and rick assessment: biomedical approaches.** Nakai, Sayaka; Sato, Koki; Tobari, Izuo; Yasuda, Norikazu; Tanaka, Akira (eds.). (National Inst. of Radiological Sciences, Chiba (Japan)). 1985. vp. (CONF-8403252—). NTIS (US Sales Only), PC A15/MF A01. Order Number DE87780119/JAW.

From 15. NIRS symposium on radiation-induced genetic damage and risk assessment: biomedical approaches; Chiba, Japan (15 Mar 1984).

Separate papers are processed for inclusion in the appropriate data bases.

1939 **(RERF-TR—5-86) Low-energy (soft) x rays. Dosimetry and cell survival.** Hoshi, Masaharu; Antoku, Shigetoshi; Russell, W.J.; Miller, R.C.; Nakamura, Nori; Mizuno, Masayoshi; Nishio, Shoji. (Radiation Effects Research Foundation, Hiroshima (Japan)). May 1987. 26p. (In Japanese and English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750290/JAW.

Dosimetry of low-energy (soft) X rays produced by the SOFTEX Model CMBW-2 was performed using Nuclear Associates Type 30 - 330 PTW, Exradin Type A2, and Shonka-Wyckoff ionization chambers with a Keithley Model 602 electrometer. Thermoluminescent (BeO chip) dosimeters were used with a Harshaw Detector 2000-A and Picoammeter-B readout system. Beam quality measurements were made using aluminum absorbers; exposure rates

were assessed by the current of the X-ray tube and by exposure times. Dose distributions were established, and the average factors for non-uniformity were calculated. The means of obtaining accurate absorbed and exposed doses using these methods are discussed. Survival of V79 cells was assessed by irradiating them with soft X rays, 200 kVp X rays, and /sup 60/Co gamma rays. The relative biological effectiveness (RBE) values for soft X rays with 0, 0.2, 0.7 mm added thicknesses of aluminum were 1.6, which were compared to /sup 60/Co. The RBE of 200 kVp X rays relative to /sup 60/Co was 1.3. Results of this study are available for reference in future RERF studies of cell survival.

1940 **(RERF-TR—7-86) Effect on intelligence of prenatal exposure to ionizing radiation.** Schull, W.J.; Otake, Masanori. (Radiation Effects Research Foundation, Hiroshima (Japan)). Jan 1987. 26p. (In Japanese and English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750069/JAW.

Analysis of intelligence test scores at 10 - 11 years of age of individuals exposed prenatally to the atomic bombing of Hiroshima and Nagasaki has revealed the following: 1) For those individuals exposed in the first eight weeks after fertilization or after the 25th week, there is no evidence of a radiation-related effect on intelligence; 2) The mean test scores but not the variances are significantly heterogeneous among exposure categories for individuals exposed at 8 - 15 weeks after fertilization, and to a lesser extent those exposed at 16 - 25 weeks; 3) The regression of intelligence score on estimated fetal tissue dose is linear or linear-quadratic for the 8 - 15 week group and possibly linear for the 16 - 25 week group; 4) The cumulative distributions of test scores suggest a progressive shift downwards in the scores with increasing exposure; and 5) Within the group most sensitive to the occurrence of clinically recognizable, severe mental retardation, individuals exposed 8 to 15 weeks after fertilization, the diminution in intelligence score under the linear-quadratic model is 21 - 27 points at 1 gray (Gy = 100 cGy = 100 rad). The effect is somewhat greater when the controls receiving less than 0.01 Gy are excluded, 33 - 41 points at 1 Gy; but the two estimates are not statistically significantly different.

1941 **(SAAS—343) Final conference on scientific-technological cooperation in the field of radiation protection between the MoH and the SAAS from 1981 to 1985. Part 3.** (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1986. vp. (CONF-8509389—Pt.3). NTIS (US Sales Only), PC A04/MF A01.

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

Scientific information is presented on the following topics: the kinetics of labelled compounds and radionuclides; the effects of ionizing radiation on occupationally-exposed women and their fetuses; and personnel dosimetry. Five individual papers for the conference are indexed separately.

1942 **(VROM-DSB—86-15) Analysis of the risk factors for exposure of the lung to low irradiation doses.** Hogeweg, B. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Feb 1986. 96p. (In Dutch). (VROM—60198/3-86). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703774/JAW.

In this report a description is presented of the risk factors for induction of lung/tumours. The contribution of natural radioactivity from uranium and thorium to the lungs is mainly caused by inhalation of alpha-emitting radon and thorium daughter products. Apart from exposure by inhalation the lungs are also exposed to external radiation. For internal as well as external exposure a value of 10/sup -3/ lung/cancers per Sv lung dose equivalence is found to be acceptable for the riskfactor. (Auth.). Includes English summary; 109 refs.; 10 figs.; 15 tabs.

1943 **(VROM-DSB—86-24) Influence of radioactive effluents from nuclear installations on mortality of the woods.** Stoutjesdijk, J.F. (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming). Nov 1986. 38p. (In Dutch). (VROM—60941/11-86). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703779/JAW.

Referring to a theory of Reichelt that radioactive materials, effused from nuclear installations and uranium ores, can contribute to mortality of the woods, it is checked, by studying corresponding literature, to what extent this agrees with the facts. According to this study the radionuclides seem to contribute to the internal and external radiation doses of plants. However these doses are so small with respect to natural radiation doses that it is highly unprobable that this effect contributes to damage of the woods. (Auth.). 69 refs.; 6 figs.; 11 tabs.

1944 **Technical evaluation of draft ANSI Standard N13.30, "Performance Criteria for Radiobioassay".** MacLellan, J.A.; Traub, R.J. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). pp 4.3 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

To evaluate the appropriateness of the draft Standard, a research program, entitled Technical Evaluation of Draft ANSI Standard N13.30, "Performance Criteria for Radiobioassay," was initiated at the Pacific Northwest Laboratory (PNL). This program incorporates a number of tasks including a nationwide, two-round intercomparison study to test the analytical performance of both in-vitro and in-vivo bioassay laboratories and determine their ability to meet the minimum performance criteria specified in the American National Standards Institute (ANSI) draft Standard, and other tasks related to the establishment of an accreditation laboratory. Based on two rounds of in-vitro testing and the in-vivo pilot study, the project staff has concluded that the criteria selected are appropriate for the existing state of the industry and achievable by most participating laboratories. Specific conclusions are as follows: the AMDA criteria are most difficult for the laboratories to achieve, the relative bias criterion is second in difficulty, and the precision criterion presents no problem for the laboratories, most of the participating laboratories can meet the Standard, and failure rates may decrease as the laboratories become knowledgeable of the performance criteria.

1945 **Determination of uranium in urine: Comparison of ICP-mass spectrometry and delayed neutron assay.** Gladney, E.S.; Moss, W.D.; Gautier, M.A.; Bell, M.G. (P.O. Box 1663, MS K484, Los Alamos National Lab., Los Alamos, NM 87545). pp 9.3 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

Los Alamos analytical chemistry group acquired a VG-Plasmaquad ICP-MS in January, 1986 and have applied the technique to a variety of environmental and bioassay analytical problems. The authors report on their experience with the determination of uranium and its isotopics in urine and compare this new method with their current uranium procedure, delayed neutron activation analysis (DNA) at the Los Alamos Omega West Reactor. The authors have utilized DNA for bioassay samples since 1978. They currently analyze approximately 2000 urine samples annually. Quantitative data on uranium concentrations are obtained by concurrent measurement of urine standards of known uranium content and isotopic ratio. Detection of 0.03 μg of normal U in a 25 mL sample (1 μg/L) can be achieved by the DNA system. The NRC has proposed new urine bioassay standards that might require at least an order of magnitude reduction in the authors current DNA detection limits. The authors have fully optimized the reactor, and can forsee no instrumental improvement. They may be forced to resort to time-consuming chemical separations at greatly increased costs. DNA is a mature technology with little prospect for radical change. ICPMS

is still in its infancy, and there are several ideas for obtaining drastic improvements in detection limits. Costs and time per analysis for both methods are equal.

1946 **Gross beta analysis using a Nova-1 for potassium-40 correction.** Simpson, T.A. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550). pp 8.4 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

The amount of natural potassium-40 in urine varies from sample to sample. Potassium-40 is a beta-emitter (1.314 MeV max) and can interfere in gross beta analysis for nuclides such as Strontium-90 and fission products. The method uses at Lawrence Livermore National laboratory for screening gross beta activity in urine are discussed. The Livermore method has proven to work well for screening large numbers of samples. Sample processing can be done in one to two days. Atomic absorption spectroscopy can also be used to confirm potassium readings when positive results do occur.

1947 **Computerized data management of an eighty detector alpha spectrometry system.** Gautier, M.A.; Jalbert, M.L.; Moss, W.D.; Ide, H.M. (Los Alamos National Lab., Los Alamos, NM). pp 8.3 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

Computer assisted methodology is developed by the Health and Environmental Chemistry Group of the Los Alamos National laboratory for the reduction of environmental and bioassay alpha spectrometry data. Alpha is a multi-purpose, menu-driven, FORTRAN code used by count room personnel to reduce calibration, background, and sample data stored in five 2048 channel Canberra Series 35 Plus analyzer systems. Each system contains a bank of 16,300-mm/sup 2/ Ortec surface barrier detectors. Energy and efficiency calibrations are performed each week on these systems using a /sup 239/242/Pu, /sup 241/Am secondary standard that is calibrated against a primary /sup 238/Pu NBS standard. The alpha calibration subroutine prints and integrates the spectrum as a function of the energy of the three calibration isotopes. The summary report tabulates the information for each sample; the /sup 238/239/242/Pu background and sample raw count data, the /sup 242/Pu tracer recovery for each sample, the corrected result with the corresponding propagated error, the sample volume and specific gravity used to correct urine analyses to a 24-hour sample, and the final result expreased in rhoCi. Sample results are calculated from the net sample counts and the calculated tracer recovery factor. In addition to plutonium, provisions in the code allow for the identification of uranium, americium, and thorium.

1948 **Alpha spectrometry: Theory vs. realism.** Moss, W.D.; Ide, H.M.; Gautier, M.A. (Los Alamos National Lab., Los Alamos, NM 87545). pp 7.5 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

This paper discusses the problems associated with acceptance of alpha spectrometry data obtained from the authors' routine bioassay program. These samples require moderate energy solution and high counting efficiency. These two criteria satisfy the measurement needs associated with the analysis of bioassay samples for actinides when the application of isotope dilution procedures are used and the tracer isotope alpha energy is separated from the analyte isotope's alpha energy by at least 100 KeV. The merit of using isotope dilution methods is proven and is without question the single most important development for identifying losses associated with the analysis of biological samples for actinides. In addition, the tracer recovery data may be used as a quality control measure to indicate the accuracy and precision of the analytical method. In the authors' laboratory, tracer recovery data are characterized by skewed distributions which range from 1% to over 100%. Because this range of recovery data is in conflict with the desired tracer recovery profile, criticism is often directed against the alpha spectrometry counting instrumentation as a cause for the wide range of tracer recovery results. Each of these criticisms directed at the counting instrumentation as a cause for poor tracer recovery are discussed. The effect of iron, on the sample plate, as a major cause for alpha particle degradation is discussed.

1949 **Needs and requirements for future bioassay programs.** Sedlet, J. (Argonne National Lab.). pp 2.2 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

Future bioassay programs should be concerned with risk as the end product. In keeping with modern methods for evaluating and comparing various types of hazards, such a system would allow one to compare and to sum the risk to an individual from different hazards, e.g., radiation, toxic chemicals, physical stress, and asbestos, and allow the individual and his employer to place all work hazards in proper perspective. Even stochastic and non-stochastic risks could be compared. It is possible that the work force will accept a nuclear industry that has a risk no greater than those of industries now considered safe, and that the public will accept a nuclear industry whose risk to the environment and the public is no greater than those of industries now considered safe. There will need to be risk assessments for radiation and other hazards that are generally accepted, but there is no present system for accomplishing this. Methods available or lacking, particularly at low levels, are reviewed and potential improvements are discussed. The greatest need is for measuring small quantities of actinides in the body, their organ distribution, and their elimination rates in affected individuals, rather then using a standard model which probably does not apply to any individual. Large are silicon diode detectors show promise for high sensitivity body measurements and for locating actinides in the body. Such measurements need to be combined with excretion measurements to obtain the mot information. Improvements in excretion measurements are available, and their use in internal exposure requires primarily the application of good radiochemistry and financial resources. Also, more detailed study for each exposure case are needed for all radionuclides since the use of general models does not give results with the accuracy needed.

1950 **Difficulties in in-vitro dose assessment due to chemical limitations.** Lardy, M.M.; Rotariu, G.J.; Robinson, A.V. (U.S. Testing Co., Inc., Richland, WA). pp 2.4 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

The current regulatory environment and the application of ALARA to radiation protection programs creates an ever increasing pressure to document and evaluate very low-level exposures. This can generally be accomplished either by tighter controls on the process, increased sampling frequency, or decreasing the MDA. In the past, the health physicist's response to these pressures generally has been to require lower and lower MDA's. The introduction of new technology has generally allowed the analytical chemist to accommodate those requests. The purpose of this paper is to point out that one is reaching MDA's that are near ambient levels (or in some cases below) and further decreases may not be feasible without significant price increases. The authors discuss some present difficulties associated with current in-vitro analyses (urine and fecal) in particular for radionuclides of major interest, such as Sr-89 and -90, U and Pu-238,239/240.

1951 **International laboratory intercomparison of actinides in human tissue.** Kathren, R.L.; Inn, K.G.W.; Liggett, W.S.; McInroy, J.F.; Kawamura, H.; Percival, D.R.; Popplewell, D.S. (Pacific Northwest Labs.). pp 3.3 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

Research program into the biokinetics and health effects of the transuranic elements in man, such as those of the United States Transuranium Registry (USTR), or studies of plutonium in humans from fallout tests conducted by several agencies including Los Alamos National laboratory and the National Radiological Protection Board in Britain, rely heavily on measurement of plutonium in human tissues. An international laboratory intercomparison was organized by the USTR in conjunction with the NBS (National Bureau of Standards). Five laboratories are initially participating in the intercomparison; three American, one British and one Japanese. Included in this group are several research laboratories. Each of the five participating laboratories was requested to perform a plutonium isotopic analysis, a uranium isotopic analysis, and an analysis for /sup 241/Am from five samples each of SRM 4351 and SRM 4352. Each laboratory was requested to perform the requisite analyses using their own specific procedures and provide the results to the USTR/NBS for analysis. Preliminary data for /sup 239+240/Pu from two different laboratories are received, one for lung and one for liver. The values do not differ appreciably from those given by NBS for the respective SRM, being within +-10%. Preliminary results are presented in this paper.

1952 **A comparison of methods for the separation of organic material from the mineral component of bone from individuals occupationally exposed to plutonium.** Miglio, J.J.; Willis, L.C.; McInroy, J.F.; Kathren, R.L. (Los Alamos National Lab., P.O. Box 1663, MS K484, Los Alamos, NM 87545). pp 5.4 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

The distribution of plutonium among the components of bone from occupationally exposed individuals can determine health effects. It is suggested that localization of plutonium in marrow may increase the risk of leukemia. An important aspect is the distribution of systematic plutonium between mineral bone and the organic material associated with bone. Four methods of separating organic material from the mineral component of bone were compared to determine the ease and completeness of separation and also to compare the uniformity of results. Methods studied were chemical separation with ethylenediamine, mechanical separation using a stream of water, separation by ultrasonic agitation, and separation by steam under pressure in an autoclave. Bone samples studied were four vertebral bodies from an occupationally exposed individual. Each vertebral body was cut in half with one half reserved for separation by ethylenediamine and the other half for separation by one of the other three methods. The most satisfactory method for removing organic material from mineral bone was extraction with ethylenediamine, even though several days are required to complete the procedure. The autoclave technique was the quickest method but appeared to remove only fat. Ethylenediamine was the only method that removed all of the organic material.

1953 **New, rapid separation of actinide elements in bioassay samples.** Fairman, W.D.; La Rosa, J.J.; Nelson, D.M.; Horwitz, E.P.; Dietz, M.L.; Tse, P.K. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). pp 6.2 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

The actinides are separated from the urine matrix by an alkaline phosphate precipitation. The precipitate is then wet-ashed or muffled and the residue taken up in 2M nitric acid-0.5M aluminum nitrate. A small amount of 0-1M ferrous nitrate solution is used to reduce any Np(V) to Np(IV). The sample solution is then added to the CMPO column, which is washed with 1M nitric acid. The actinides are stripped with 0.1M ammonium acid oxalate solution which is collected directly in an electrodeposition cell. After addition of electrolyte (5M ammonium chloride), the actinides are electrodeposited onto a polished, stainless steel planchet, which is then counted in an alpha spectrometer.

1954 **Radiochemical determination of americium, curium, and californium in urine.** Thein, M.; Gonzalez, B.D.; Bogard, J.S. (Environmental and Occupational Safety Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 6.4 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

A method for determining americium, curium, and californium in urine is developed at Oak Ridge National Laboratory (ORNL). These elements, notable for their restrictive annual limits on intake, are commonly encountered in operations at ORNL, requiring that personnel involved in processing and use of these materials be closely monitored for potential internal exposure. Suitable procedures for analysis of samples containing mixtures of these elements in a biological matrix were not previously available at ORNL for routine use. The analysis involves separation of the radionuclides by ion exchange, followed by alpha spectrometry of the electroplated sample. Americium-243 is used as an internal yield monitor. A flow diagram of the radiochemical procedure and a representative plot of the resulting alpha spectrum are presented. This procedure can be used in the presence of other actinides, provided their alpha energies can be resolved. If lanthanides are present, they may be removed by washing with NH/sub 4/SCN solution. Preliminary results are presented.

1955 **The determination of radium-226 and isotopes of thorium and uranium in feces.** Pope, D.G. (U.S. Dept. of Energy, Radiological and Environmental Sciences Lab., 785 DOE Place, Idaho Falls, ID 83402). pp 6.5 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

A method is described for the determination of Radium-226 and the isotopes of thorium and uranium in five grams of fecal ash. Radium is separated prior to the actinides by carrying on barium nitrate from a condensed phosphoric acid (CPA) nitric acid medium.

1956 **Use of laboratory robots in the automation of a urine plutonium bioassay.** Gonzales, E.R.; Moss, W.D.; Rodriguez, R.; Martinez, G.M. (Health, Safety and Environmental Chemistry Group, Los Alamos National Lab., MS K484, P.O. Box 1663, Los Alamos, NM 87545). pp 10.5 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

Determination of plutonium in urine is a routine procedure performed at Los Alamos. Samples are taken from the many workers who handle plutonium in their day to day activities and from those individuals whose jobs may bring them into contact with this metal. The analytical procedure used is based on alkaline earth phosphate precipitation that coprecipitates the plutonium. This procedure gives excellent results but it involves many manipulative steps and the chances for human error are ever present. In order to eliminate potential human error and decrease analysis time this procedure was automated using a Zymark Corporation robotic workcell. The developmental work for the automation process was divided into two parts: robot programmatic needs - software and

hardware, and chemical modifications of existing methods for utilization with the robotic system. The optimum integration of these developments are discussed in this paper.

1957 **A simplified plutonium bioassay procedure.** Moss, W.D.; Gonzalez, E.R.; Rodriguez, R.M.; Martinez, G.M.; Ide, H.M. (Los Alamos National Lab., Los Alamos, NM 87545). pp 5.5 of Proceedings of the 32nd annual conference on bioasssay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

The major changes from the reported procedure is., the coprecipitation and slurry dissolution steps are performed in 1-L Teflon bottles at room temperature. The use of Teflon bottles to mix, precipitate, dissolve, and heat the sample solutions simplifies the sample handling requirements associated with the sample volume. Because the urine samples are not heated prior to dissolution in 8 M HNO/sub 3/ there are no insoluble organic materials formed which may slow flow through the short 3-cm long anion exchange resin bed column. The procedure works on the theory that excreted Pu is characterized by /sup 242/Pu tracer added to the raw urine sample prior to the precipitation step. Measurement of plutonium concentration per 24 hour urine collection at the 0.0007 Bq (0.02 pCi) detection level are achieved. Details of the analytical chemistry and alpha decay measurement methods are presented.

1958 **Measurement of attocurie levels of /sup 239/Pu in urine using fission track analysis.** Moorthy, A.R.; Schopfer, C.J. (Safety and Environmental Protection Div., Brookhaven National Lab., Upton, NY 11973). pp 10.1 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

A method is developed for the measurement of /sup 239/Pu by fission track analysis (FTA), a procedure that is about 50 to 100 times more sensitive than alpha spectrometry. One day's output of urine is wet ashed with nitric acid, and plutonium is separated from interfering elements in two stages. Initial separation is done with a 6 mL column containing Dowex-1 anion exchange resin. The column effluent is concentrated and further purified through use of a microcolumn containing 0.035 mL of the resin. An aliquot is evaporated on a pre-cleaned synthetic fused silica detector on an area of about 1 cm/sup 2/. Detectors are irradiated in a thermal neutron fluence of 10/sup 17//cm/sup 2/. The resulting fission-fragment tracks are then enlarged by etching with concentrated HF and are counted manually with a light microscope.

1959 **Domestic and personal determinants of the contamination of individuals by household radon daughters.** Stebbings, J.H.; Kardatzke, D.R.; Toohey, R.E.; Essling, M.A.; Pagnamenta, A. (Argonne National Lab., IL). *Trace Substances in Environmental Health;* 392-400(1986). (CONF-860626—). Contract W-31-109-ENG-38.

From 20. annual conference on trace substances in environmental health; Columbia, MO, USA (2 Jun 1986).

Radon daughters were counted by gamma spectroscopy from 180 adult residents of eastern Pennsylvania during the winter of 1983-84. Body radon daughter contamination is an index of relative individual respiratory exposures to radon daughters. Body radon daughter counts can be related both to household radon levels, and to personal risk factors such as sex and tobacco smoking. A 35-minute, seven-position scan was carried out in a mobile body counter using a NaI crystal. Track-Etch detectors for household radon were distributed to 86% of the subjects; 80% were recovered. More than 75% of this Pennsylvania population appeared to have environmentally enhanced radon daughter contamination; 59% had counting rates greater than 2 s.d. above background. House radon levels were the major determinants of radon daughter contamination in the 112 subjects for which both sets of measurements were available. Both sex and cigarette smoking ($p < .01$) significantly modified that relationship, after nonlinear adjustment for travel times. Using a logarithmic model, a given house radon level was associated in females with body contamination by radon daughters 2-3 times that in males. Nonsmokers had 2-4 times higher levels of contamination than smokers. For female nonsmokers relative to male smokers the excesses multiply. These results are for total contamination, both internal and external. Total contamination may be a better index of individual exposures in the breathing zone than a long-term room measurement. The time usage and activity patterns of the subjects must be considered in explaining these findings. 8 references, 6 tables.

1960 **Radiation-protective drugs and their reaction mechanisms.** Livesey, J.C.; Reed, D.J.; Adamson, L.F. Park Ridge, NJ; Noyes Publications (1985). 158p.

From review in J. Environ. Sci. Health, Vol. A21, No. 4 (1986).

This book describes effects of radiation on biological systems, endogenous factors which influence radioresistance, chemical radioprotection, therapy of radiation damage, recommendations for future work, chemical radioprotection - research in progress and some compounds showing radioprotective activity.

1961 **Response of CHO cell DNA polymerase alpha to dCTP and dTTP pool imbalance: relation to DNA synthesis inhibition, survival and mutation.** Newman, C.N.; Miller, J.H. (Pacific Northwest Lab., Richland, WA). pp 127-148 of Genetic consequences of nucleotide pool imbalance. de Serres, F.J. (ed.). New York, NY; Plenum Publishing Corporation (1985). Contract AC06-76RL01830.

Utilizing a dNTP pool-altered, polymerase α-altered mutant of CHO-K1 and a permeable cell-DNA synthesis system, the present study examines the complicated interrelationship of dNTP pools as potential regulators as well as substrates for polymerase α. These findings are then related to the commonly observed UV-induced inhibition of DNA synthesis, and, ultimately, to the biological consequences of exposure to radiation and chemical insults.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 46, 108, 110, 111, 265, 617, 618, 1701, 1703, 1704, 1717, 1805, 1859, 1862, 1866, 1906, 1909

1962 (KFK-PEF—12-Vol.2, pp 499-510) **Influence of the surface structure of leaves and needles of forest trees on the content of sulphur and the deposition and uptake of metals.** Schreiber, H.; Rentschler, I. (Hohenheim Univ., Stuttgart, Germany, F.R. Inst. fuer Physik). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

Continuing the investigations of the elemental contents of needles and bark from fir and spruce we took samples at different places with partly high airborne particle concentrations of lead, copper, iron and zinc. Considerable amount of the surface contamination can be found transfered to the bark resulting in very high contents in the older parts of bark material. In a first test we applied the statistical method of spectral analysis to quantify the differences in the structures of the waxy layer on needles.

1963 (KFK-PEF—12-Vol.2, pp 697-707) **Effects of SO/sub 2/ induced damage of bronchial epithelium on sensitization by inhaled allergens.** Riedel, F.; Kraemer, M.; Scheibenbogen, C.; Rieger, C. (Marburg Univ., Germany, F.R. Zentrum fuer Kinderheilkunde). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The effect of sulphur dioxide (SO/sub 2/) induced damage of bronchial mucosa on local bronchial sensitization to inhaled antigens (0.1% Ovalbumin) was studied in the guinea pig. Inhalation of SO/sub 2/ (0.1 - 4.3 - 16.6 ppm) for 8 hours on 5 consecutive days was followed by 0.1% Ovalbumin inhalation for 45 min on the last 3 days. Following repeated Ovalbumin inhalations over 2 weeks bronchial obstruction was investigated by plethysmographic lung

function measurements (bronchial provocation). Specific serum antibodies against Ovalbumin increase in the SO/sub 2/-damaged group but not in the control group. It is concluded that SO/sub 2/ induced damage of bronchial mucosa can facilitate local allergic sensitization on the guinea pig.

1964 (KFK-PEF—12-Vol.2, pp 709-719) **Damage to cultured lung cells by inhalation noxes.** Ebert, W.; Moll, E.; Vogt-Moykopf, I.; Komitowski, D. (Thoraxklinik Rohrbach, Heidelberg, Germany, F.R.; Deutsches Krebsforschungszentrum, Heidelberg, Germany, F.R. Inst. fuer Experimentelle Pathologie). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

The influence of air pollutants on cell populations of the respiratory tract was studied by applying an in vitro model. Endothel cells and pneumocytes (type II cells) are cultured in modified Pentz' chambers and treated with O/sub 3/ and NO/sub 2/. Impairment of lung cells is indicated by release of lactatdehydrogenase (LDH) into the culture medium and staining by trypan blue (trypan blue exclusion-test). 0,05-0,1 ppm O/sub 3/ as well as 1-5 ppm NO/sub 2/ are able to damage endothel cells. Pneumocytes are more stable. They are damaged by a minimum dosis of 0,3 ppm O/sub 3/. Those concentrations lie within the values of maximal burden of immission measured in town centres. Sedimentation and adhesion properties of the cells are diminished depending on concentration of the pollutants. Electronmicroscopic studies reveal alterations of cell nuclei and cytoplasma of the treated cells which are quantified by use of an image analyzing system.

1965 (KFK-PEF—12-Vol.2, pp 721-738) **Analysis of bronchoalveolar lavage proteins as a marker for cellular injury in terminal lung tissue due to inhalative noxes.** Mueller, B.; Wichert, P. v. (Marburg Univ., Germany, F.R. Medizinische Poliklinik). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

Rats were exposed to defind concentrations of SO/sub 2/ and NO/sub 2/ over certain periods. The effects of gas-exposition on lung surfactant metabolism were studied analysing the bronchoalveolar lavage. Concerning the protein component of the bronchoalveolar lavage it was found that in contrast to phospholipid subclasses single proteins do alter: the content of albumin is enhanced and the lavage-specific proteins were decreased when analysed with electrophoretic and densitometric procedures. Since the alteration of the lavage specific proteins is altered more distinctly than that of the serum identical ones we think that determination of specific proteins is a valuable instrument measuring lung damage as caused by air-pollution.

1966 (KFK-PEF—12-Vol.2, pp 739-751) **In vitro and in vivo studies of the carcinogenic, toxic and genotoxic activities of the air pollutants SO/sub 2/ and NO/sub x/, separately and in combination with carcinogenic polycyclic aromatic hydrocarbons and N-nitrosamines.** Klein, R.G.; Pool, B.L.; Schmezer, P.; Zeller, W.J. (Deutsches Krebsforschungszentrum, Heidelberg, Germany, F.R. Inst. fuer Toxikologie und Chemotherapie). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

This paper describes in vitro and in vivo studies on the effects environmental pollutants SO/sub 2/ or NO/sub x/ may exert on biological activities of chemical carcinogens. Analysis of basic physical and chemical parameters were first performed in order to establish the rate of SO/sub 2//NO/sub x/ absorption through the culture medium. It was shown that the pH remains constant for 24 hours of exposure and that the concentration of both pollutants in the liquid phase is more dependent on their concentration in the gas phase than on exposition time. The measurement of various enzymic parameters revealed a distinct decrease in the activity of lactate dehydrogenase after 1, 3, and 5 hours of exposure to 200 ppm SO/sub 2/. Various in vitro parameters were assayed in fetal hamster lung cells, rat hepatocytes and the cell line CO60. For the determination of toxic effects, it was shown that the plating efficiency was a more sensitive parameter than the assay for trypan blue exclusion. The induction of DNA single strand breaks as an indicator of genotoxic effects showed that SO/sub 2/ application decreased the rate of strand breaks by α-acetoxy-methyl-methylnitrosamine, when compared to the effects this compound induced on its own or in combination with NO/sub x/. Systemic effects have not been observed after treating animals with the pollutants (50 ppm, respectively, 2 weeks) and analysing different susceptibility parameters of explanted liver cells. The additional treatment of CO60 cells with SO/sub 2/ or NO/sub x/ did not influence the DNA amplification rate induced by benzo(a)pyrene or dimethylbenzanthracene.

1967 (KFK-PEF—12-Vol.2, pp 753-767) **Epidemiological cross-section study on the effects of air pollution in school children.** Klinger, L. (Heidelberg Univ., Germany, F.R. Inst. fuer Sozial- und Arbeitsmedizin). Apr 1987. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE87753279/JAW. (CONF-8703151—Vol.2).

From 3. PEF status colloquium of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (10 Mar 1987).

In the towns of Mannheim and Freiburg, in the southern part of the Rhine valley and the Black Forest 5,819 school children, aged 16 to 17, were examined for influences of regionally different levels of air pollution. Apart from a questionnaire on respiratory symptoms and diseases, a medical examination and lung function tests were performed. The regional distribution of prevalences of respiratory symptoms and diseases is heterogeneous, the influence of air pollution appears to be definitely lower in comparison with the influence of smoking behaviour. Consistent effects of length of time living in the area, number of rooms and sort of cooking fuel could not be proved. The parameters of lung function (PEFR, VC, FVC, FEV 1.0 and MMEF) didn't show any significant regional differences. There are problems of the epidemiological method especially with regard to the reduced levels of air pollution, which complicate comparisons with earlier studies and make it necessary to modify the traditional design. Problems arise as well with the increasing importance of the individual load with toxic agents.

1968 **(KFK-PEF—19) Investigation of the wood properties of diseased spruce and fir from Baden-Wuerttemberg based on tests of small clear specimens and wooden beams of structural dimensions.** Grammel, R.H.; Becker, G.; Gross, M.; Hoewecke, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Nov 1986. 91p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753268/JAW.

During investigation of forest disease 182 spruce and 144 fir trees from the main stands in Baden-Wuerttemberg with different degrees of disease were examined with respect to some wood properties. The investigation included tests of the bending strength of wooden beams of usable dimensions, as well as small clear specimens. The test results of bending strength, compression strength parallel to the grain, impact bending and modulus of elasticity show no significant differences in mean values and variation when compared with known values obtained from healthy trees. Negative changes in the properties investigated were not found to be dependent upon the degree of disease. No relation was found between nutrition element content of needles, degree of infection with spruce needle fungi, and the degree of disease.

1969 **(NP—7770310) Reasons for forest decline. Status report on the scientific discussion. 2. Rev. and Enlarged Ed.** Rocholl, M.; Setzer, B.; Vollbrecht, P. (Arbeitsgemeinschaft Waldsterben Freiburger Biologiestudenten in der Initiative Schwarzwald, Freiburg im Breisgau (Germany, F.R.)). Jun 1986. 48p. (In German). NTIS (US Sales Only), PC A03. Order Number DE87770310/JAW.

This report tries to introduce all possible causes of forest decline known up to this day. On the description of the most important air pollutants the short but exact representation of the different hypotheses is followed.

1970 (NP—7770328) Morphology of crown development in F. sylvatica L. (red beech) in consideration of possible recent changes. Roloff, A. (Goettingen Univ. (Germany, F.R.). Forschungszentrum Waldoekosysteme - Waldsterben; Goettingen Univ. (Germany, F.R.). Forstwissenschaftlicher Fachbereich). 1986. 186p. (In German). NTIS (US Sales Only), PC A09. Order Number DE87770328/JAW.

The criteria chosen for the assessment of 'new types of damage' in deciduous trees were development of shoots and leaves, fall of leaves, crown morphology. All three criteria were found to be highly correlated with climatic factors and with pollutant concentrations. Aerial pictures can be evaluated on the basis of these criteria.

1971 (ORNL/TM—10443) A brief summary of the OSHA interim final rule on "hazardous waste operations and emergency response" and implications for federal facilities. Baes, C.F. III; Mrochek, J.E.; Aldrich, T.E.; Glatthaar, C.L. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000023/JAW.

This report is a short briefing document to help OEGC in understanding the scope and provisions of the Occupational Safety and Health Administration's (OSHA's) interim final rule for protection of workers engaged in operations involving hazardous waste, assessing the rule's impact on hazardous waste operations conducted by the DOE and its contractors, and preparing guidance to DOE field offices for compliance with the rule. The rule, "Hazardous Waste Operations and Emergency Response; Interim Final Rule," is effective immediately and remains in effect until a final rule is promulgated by October 17, 1988. The new rule adds a new section containing employee protection requirements for workers engaged in hazardous waste operations, including emergency response to hazardous substance incidents. The rule includes provisions for site characterization, analysis, and control; employee training and medical surveillance; and engineering controls, work practices, and personal protective equipment (PPE). Workers engaged in hazardous waste activities are to receive 40 hours of classroom training and 3 days of field training before working at hazardous waste sites. Additional training is required for workers exposed to unique or special hazards and managers and supervisors directly responsible for hazardous waste site operations. It is not clear whether a federal facility, itself, or its contractor must train contract workers, although the rule indicates that such training must occur before hazardous substance and waste handling operations commence. For purposes of confidentiality, any training or medical records retained by a facility for purposes of compliance with the rule should be maintained separate from other employee personal records. States may enact more stringent standards. 4 refs., 1 tab.

1972 (PB—87-199071/XAB) New methods to screen for lead exposure. Final report, 1 March 1984-28 February 1986. Guthrie, R. (State Univ. of New York, Buffalo (USA). Dept. of Pediatrics). Feb 1986. 13p. NTIS, PC A02/MF A01.

The project attempted to develop a sensitive and relatively inexpensive screening test for undue lead exposure which will facilitate the implementation of periodic screening and monitoring of pre-school children for this important health problem. Blood lead determination, a complicated procedure, is necessary following a positive EP test in order to identify lead toxicity. Since EP can be done on either liquid blood or dried-blood specimens on filter paper, the study explored the use of the latter to assay lead-sensitive phosphatase activity in blood. The development of this technique would make possible the use of a single dried-blood spot specimen on filter paper obtained by finger prick. It would also greatly facilitate mass screening and monitoring of young children for two of the most-prevalent preventable illnesses; increase efficiency and cost effectiveness of screening, sample collection, storage, handling, and transportation. The project failed in its primary goal, during the two-year period of the grant, to develop a simple test on a dried blood spot specimen which would distinguish between iron deficiency and lead exposure in a specimen where an EP elevations had already been found. However, the investigators are now pursuing this same goal with a different approach, the determination of one of the earlier intermediates in heme biosynthesis that should be increased due to lead exposure, but not because of iron deficiency.

1973 (PB—87-209292/XAB) Mutagenic activity of the photooxidation products of $C_6H_5NH^3/C_2H_4/NOx$ mixtures. Shepson, P.B.; Kleindienst, T.E.; Edney, E.O.; Namie, G.R.; Pittman, J.H. (Northrop Services, Inc., Research Triangle Park, NC (USA)). 1985. 19p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Environmental Science and Health A20, No. 5, 503-519(1985).

Mixtures of aniline/ethylene/NOx were photolyzed in a 22.7-m^3 Teflon reaction chamber operated in a dynamic mode. Several minor products, including nitrobenzene, azobenzene, alpha-nitroaniline, phenol, and benzoic acid, were identified. The production of aerosol was also observed. The product mixtures were exposed to Salmonella typhimurium strains TA98 and TA100 both with and without metabolic activation. Exposures of the gas mixture alone and the aerosol plus gas mixture were performed. In addition, filters of the aerosol were collected, extracted, and used in a plate incorporation procedure with these strains. The results show the gas-phase products from the irradiated mixture to be relatively nonmutagenic in TA98 and TA100. This same result was found in the aerosol exposure, although the deposition into the media may have been low. However, extracts from the aerosol when directly incorporated into the medium show mutagenic activity for TA98.

1974 (PB—87-212544/XAB) Comparative study of various methods used for determining health effects of inhaled sulfates. Drummond, J.G.; Aranyi, C.; Schiff, L.J.; Fenters, J.D.; Graham, J.A. (IIT Research Inst., Chicago, IL (USA)). 1986. 17p. NTIS, PC A02/MF A01.

Pub. in Environmental Research 41, 514-528(1986).

Various health-effect parameters were compared to determine which tests were the most-sensitive indicators of toxic effects of exposure to metallic sulfate aerosols. Inhalation studies were conducted involving either single 3-hr exposure to various concentrations of cupric sulfate (o.43-2.64 mg/m^3 SO_4), and aluminum ammonium sulfate (1.47-3.81 mg/m^3 SO_4) or multiple (five and ten) daily 3-hr exposures to cupric sulfate (0.1 mg/m^3 SO_4). Cupric sulfate was the most toxic of the three sulfates, but the differences between the toxicity of the aluminum sulfate and aluminum ammonium sulfate were less clear.

1975 (PB—87-212908/XAB) Respiratory effects of low-level ozone exposure: clinical studies. McDonnell, W.F. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Jul 1987. 30p. (EPA—600/D-87/223). NTIS, PC A03/MF A01.

The purpose of this paper is to review results of some of the controlled-chamber studies of humans exposed to ozone. The respiratory effects known to occur during and following an acute exposure to ozone are described. This is followed by a description of the conditions under which effects can be expected in man and of the populations in which these effects can be observed. The paper concludes with discussions of the health consequences of these effects and with the phenomenon of attenuation of response following repeated exposures.

1976 (PB—87-216206/XAB) Effects of ozone and sulfur dioxide on processing tomato yields and quality. Final report. Brewer, R.F. (California Univ., Parlier (USA). Kearney Agricultural Center). 1 Mar 1986. 36p. NTIS, PC A03/MF A01.

The object of the experiment was to study the effects of SO_2 and/or ozone on tomato vegetative growth, fruit yields, and fruit quality. Two varieties of processing tomatoes, UC-204-B and E-6203, were exposed to four levels of ozone and two levels of SO_2. Exposure to ambient ozone caused a 20% reduction in vine weights and 27% reduction in weight of red fruit compared to filtered air. Exposure to 0.1 ppm SO_2 produced 7% fewer vines and approximately 8% less fruit as compared with no SO_2 exposure. Fruit quality tests indicated that increasing ozone levels reduce soluble solids (Brix), and they reduce viscosity, an important indicator of processing behavior. Exposure to SO_2 in the concentrations used increased

total solids but had no measurable effect on viscosity or consistency.

1977 **(PB—87-216438/XAB) Summary review of the health effects associated with propylene oxide: health-issue assessment.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Jun 1987. 40p. (EPA—600/8-86/007F). NTIS, PC A03/MF A01.

This report provides a brief summary of the data available on the health effects of exposure to propylene oxide. Emphasis is placed on determining whether there is evidence to suggest that propylene oxide exerts effects on human health under conditions and at concentrations commonly experienced by the general public. Both acute and chronic effects are addressed, including general toxicity, teratogenicity, mutagenicity, and carcinogenicity. To place the health effects discussion in perspective, the report also summarizes air-quality aspects of propylene oxide in the United States, including sources, distribution, fate, and concentrations associated with certain point sources.

1978 **(TVA/ONRED/AWR—87/40) Response of rainbow trout to variable dissolved oxygen regimes.** Young, R.C. (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development; Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Jul 1987. 39p. NTIS, PC A03/MF A01. Order Number DE88900015/JAW.

The effect of various levels of dissolved oxygen (DO) was tested on rainbow trout in large outdoor channels in the aquatic research laboratory. One hundred fifty trout were stocked in deep channels where oxygen was removed with nitrogen gas to produce target DO levels of 6, 4, and 2 mg/l and an untreated control channel for 80 days. The system failed during cold weather and fluctuation of DO levels in the treatments actually produced mean values of 7.9, 6.3, and 4.7 mg/l during the study. Significant findings were: (1) trout exposed to mean DO of 7.9 and 6.3 mg/l did not differ in their growth from the control; (2) trout exposed to mean DO of 4.7 mg/l had growth rates significantly lower than the control; (3) fish fed more actively in the control and 7.9 mg/l treatment than in the treatments with lower DO concentrations; and (4) Environmental Protection Agency's (EPA) 30-day mean, 7-day mean minimum, and 1-day minimum DO criteria for adult life stages of coldwater fish were violated in the treatments with mean DO values of 6.3 and 4.7 mg/l. Better definition of the numerical criteria will require additional laboratory, mesocosm, and field studies to confirm effects on rainbow trout growth. 5 refs., 8 figs., 3 tabs.

1979 **Formaldehyde dose-response in healthy nonsmokers.** Kulle, T.J.; Sauder, L.R.; Hebel, J.R.; Green, D.J.; Chatham, M.D. (Univ. of Maryland, Baltimore). *Journal of the Air Pollution Control Association;* **37**: No. 8, 919-924(Aug 1987). Contract AS05-84ER60192.

Industrial, commercial, and domestic levels of formaldehydes exposure range from <0.1 to >5.0 ppm. Irritation of the eyes and upper respiratory tract predominate, and bronchoconstriction is described in case reports. However, pulmonary function and irritant symptoms together have not been assessed over a range of HCHO concentrations in a controlled environment. The authors investigated dose response in both symptoms and pulmonary function associated with 3-h exposures to 0.0-3.0 ppm HCHO in a controlled environmental chamber. Ten subjects were randomly exposed to 0.0, 0.5, 1.0, and 2.0 ppm HCHO at rest plus 2.0 ppm HCHO with exercise and nine additional subjects were randomly exposed to 0.0, 1.0, 2.0, and 3.0 ppm HCHO at rest plus 2.0 ppm HCHO with exercise. Significant dose-response relationships in odor and eye irritation were observed ($p < 0.05$). Nasal flow resistance was increased at 3.0 ppm ($p < 0.01$), but not at 2.0 ppm HCHO. There were no significant decrements in pulmonary function (FVC, FEV_1, FEF/sub 25-75%/, SGaw) or increases in bronchial reactivity to methacholine (log PD/sub 35SGaw/) with exposure to 0.5-3.0 ppm HCHO at rest or to 2.0 ppm HCHO with exercise.

1980 **Competition in old-field perennials under CO_2 enrichment.** Wray, S.M.; Strain, B.R. (Duke Univ., Durham, NC). *Ecology;* **68**: No. 4, 1116-1120(Aug 1987). Contract AS05-83ER60177.

Differential response of individual species to increasing atmospheric CO_2 concentrations may change community structure in natural ecosystems. Some species of old-field annuals show increases in competitive potential under exposure to increased CO_2 concentrations so that their relative contribution to community production increases. Species with the C_3 photosynthetic pathway typically increase, whereas species with the C_4 photosynthetic pathway decrease in size and absolute contribution to community production. Aster pilosus (aster), a species with the C_3 photosynthetic pathway, is often the dominant perennial in fields 2-3 yr after abandonment. Andropogon virginicus (broomsedge), a grass species with the C_4 photosynthetic pathway, out competes and replaces aster during the next several years. When grown individually, aster increases in size, whereas broomsedge does not increase under CO_2 enrichment. Thus, the present competitive interaction between these species could change if the atmospheric CO_2 concentration continues to increase. A simplified de Wit Replacement Series was used to study the competitive interaction between aster and broomsedge under three CO_2 regimes.

1981 **Effect of temperature on the occurrence of O_2 and CO_2 insensitive photosynthesis in field grown plants.** Sage, R.F.; Sharkey, T.D. (Desert Research Institute, Reno, NV). *Plant Physiology;* **84**: No. 3, 658-664(Jul 1987). Contract FG08-84ER13234.

The sensitivity of photosynthesis to O_2 and CO_2 was measured in leaves from field grown plants of six species (Phaseolus vulgaris, Capsicum annuum, Lycopersicon esculentum, Scrophularia desertorum, Cardaria draba, and Populus fremontii) from 5°C to 35°C using gas-exchange techniques. In all species but Phaseolus, photosynthesis was insensitive to O_2 in normal air below a species dependent temperature. CO_2 insensitivity occurred under the same conditions that resulted in O_2 insensitivity. A complete loss of O_2 sensitivity occurred up to 22°C in Lycopersicon but only up to 6°C in Scrophularia. In Lycopersicon and Populus, O_2 and CO_2 insensitivity occurred under conditions regularly encountered during the cooler portions of the day. Because O_2 insensitivity is an indicator of feedback limited photosynthesis, these results indicate that feedback limitations can play a role in determining the diurnal carbon gain in the field. At higher partial pressures of CO_2 the temperature at which O_2 insensitivity occurred was higher, indicating that feedback limitations in the field will become more important as the CO_2 concentration in the atmosphere increases.

1982 **Generation of biologically active substances in a natural gas flame.** Braun, A.G.; Pakzaban, P.; Toqan, M.A.; Beer, J.M. (Massachusetts Institute of Technology, Cambridge). *Environmental Health Perspectives;* **72**: 297-303(Jun 1987). Contract AC02-83ER60174.

Samples of gaseous and solid species taken from the central axis of a 1 megawatt heat-input natural gas flame were tested in vitro for mutagenic activity and teratogenic potential. Mutagenicity was determined by a Salmonella typhimurium forward mutation assay. Potential teratogenicity was indicated by the ability of samples to interfere with the attachment of mammalian cells to a lectin coated surface. Both the mutagenic and anti-attachment activities were found to peak in samples originating from the flame regions where the total polyaromatic compound (PAC) species concentration reached a maximum, indicating a strong correlation between PAC presence in the samples and biological activity. Additional anti-attachment activity was found close to the injection nozzle. No biologically active material was detected beyond the luminous portion of the flame.

1983 **Photoevolution of hydrogen from Chlamydomonas sp. in the presence of CO_2.** Graves, D.A.; Greenbaum, E. (Oak Ridge National Lab., TN). *Plant Physiology, Supplement;* **83**: No. 4, 61(Apr 1987). (CONF-8707108—). Contract AC05-84OR21400.

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

Chlamydomonas reinhardtii and C. moewusii are known to photoevolve O_2 and H_2 at 22°C under anaeroblosis and in the absence of CO_2. Under these conditions the ratio of H_2 and O_2 is very nearly 2, indicating that essentially all electrons generated by the photolysis of H_2O are expressed as H_2. In an atmosphere of 1%

CO_2 in He, steady-state photoproduction of H_2 was completely inhibited at 22°C, with the only detectable production of H_2 being a transient burst which accompanied the onset of irradiation. The maximum ratio of H_2 to O_2 during the burst was ca. 0.2. Carbon dioxide also caused a >10-fold increase in O_2 photoevolution. Chilling the cells to 0°C in the presence of CO_2 reduced the rate of O_2 evolution to slightly less than that observed in the absence of CO_2; the maximum ratio of H_2 to O_2 approached 2; and sustained H_2 evolution occurred with an H_2/O_2 ratio of ~ 1, indicating that as much as one-half of the electrons generated by the photolysis of H_2O were shunted to hydrogenase. The pathway for CO_2 reduction and the mechanism by which CO_2 regulates photosynthesis appear to be more sensitive to temperature than the pathway for H_2 evolution. This may be a reflection of the complexity of the relatively simple H_2 evolution pathway (ferredoxin → hydrogenase) versus the more complex, multi-enzyme Calvin cycle.

1984 **Selenium accumulation and selenium-salt co-tolerance in five grass species.** Wu, L.; Huang, Z.; Burau, R.G. (Univ. of California, Davis). *Plant Physiology, Supplement;* 83: No. 4, 165(Apr 1987). (CONF-8707108—).

From Annual meeting of the American Society of Plant Physiologists; St. Louis, MO, USA (19 Jul 1987).

Five grass species including Tall fescue (Festuca arundinaceae Schred), Crested wheatgrass (Agropyron deserorum Fisch), Buffalo grass (Buchlor dactyloides (Nutt.) Engelm.), Seaside bentgrass (Agrostis stolonifera L.) and Bermuda grass (Cynodon dactylon (L.) Pers., Syn.) were examined for selenium and salt tolerance and selenium accumulation under solution culture conditions. Distinct differences in both selenium and salt tolerance were detected among the five species, but no direct association between selenium and salt resistance was found. Tall fescue displayed considerable tolerance under 1 ppm selenium and 100 mM salt treatment. Combined selenium and salt treatment revealed that selenium uptake was increased by the incorporation of salt in the culture solution. However, salt uptake was not significantly affected by the presence of selenium in the culture solution. At moderate toxic levels of selenium, the species with greater tolerance accumulated less selenium than did the less tolerant species.

1985 **Dose-response models for energy-based pollutants.** Jones, T.D.; Walsh, P.J. (Oak Ridge National Lab., Oak Ridge, TN). pp 436-443 of Energy solutions today for the nineties. Chu, S.L. New York, NY; American Society of Civil Engineers (1987). (CONF-870435—). Contract AC05-84OR21400.

From Energy '87: energy solutions today for the nineties; Atlantic City, NJ, USA (27 Apr 1987).

Production of energy results in increased levels of environmental pollutants, both radioactive and chemical. Pollutants may result from the manufacture of materials for production facilities, consumption of fossil or nuclear fuels, or leakage and spills associated with energy or chemical distribution systems. Two risk assessment problems common to all energy options include; the analysis of dose-response type information in test animals (considered to be reasonable analogues of man) and the use of disease rates in animals tested at very high doses to assess how man might be impacted when concentrations in food, water, and air are lower than experimentally tested doses by several orders of magnitude. An additional problem is that, in fossil-based systems, chemical compounds and complex mixtures are so numerous that a few reference chemicals must be used to consider health and safety issues deriving from thousands of chemical compounds and complex mixtures. Thus, benzo(a)pyrene is often taken as an index for polynuclear aromatic hydrocarbons; benzene for aromatic hydrocarbons and organic volatiles; benzidine for aromatic amines; and chromium (VI) for trace metals. This paper presents new ways to interpret large volumes of biological test data from many diverse experimental designs and demonstrates how this understanding can be coupled to risk factors derived from epidemiology. Dose-response estimates of human risk (resulting from a 50-year exposure period) are given for concentrations of benzo(a)pyrene, benzene, benzidine, and chromium (VI) ranging from 1 pg/m/sup 3/ to 1μm/sup 3/.

1986 **Development and application of a framework for assessing the economic impacts of air pollution on forests.** Callaway, J.M.; Nesse, R.J. (Pacific Northwest Lab., Richland, WA, USA). pp 155-169 of Strategic planning in energy and natural resources. Lev, B. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (North-Holland) (1987). (CONF-8604185—). Contract AC06-76RL01830.

From 2. symposium on analytic techniques for energy, natural resources, and environmental planning; Philadelphia, PA, USA (3 Apr 1986).

This paper describes the methods used to evaluate the economic impacts of air pollution-induced reductions in forest growth in the eastern United States for the 1985 Damage Assessment. Estimates of the effects of simulated reductions in forest growth on growing stock inventories, stumpage and primary wood product markets, and on the economic well-being of buyers and sellers in these markets are presented. Generally speaking, the estimated economic effects should be interpreted with appropriate regard for the uncertainties about the physical effects of air pollutants on forest growth and the assumptions required to perform the economic analysis. Nevertheless, the general pattern of economic impacts which emerges from the analysis is fairly robust to increases in the intensity of the simulated growth reductions and, as such, the results of the simulations appear to be generally suggestive of the kinds of impacts which could occur due to increases in air pollution.

1987 **Use of pharmacokinetics in risk analysis.** Travis, C.C. (Oak Ridge National Lab., TN). *Trace Substances in Environmental Health;* 194-203(1986). (CONF-860626—).

From 20. annual conference on trace substances in environmental health; Columbia, MO, USA (2 Jun 1986).

Quantitative risk assessment for carcinogenic chemicals is usually based on data obtained in animal studies conducted at very high levels of exposure. A key issue in using such data is extrapolation of the results from animals to man. Recently, physiological pharmacokinetic (P-P) models have been used to improve the accuracy of such extrapolations. Model results for inhalation of tetrachloroethylene will be presented and compared to experimental data for rats with humans. Scaling physiological parameters allowed them to successfully extrapolate results from rats to humans. 10 references, 3 figures, 4 tables.

5604 Other Environmental Pollutant Effects

1988 **(AD-A—182806/0/XAB) Time-dependent inverse methods for finding currents and initial conditions which lead to prescribed signals. Final report, 1 July 1986-30 June 1987.** Moses, H.E. (Lowell Univ., MA (USA). Research Foundation). 30 Jun 1987. 3p. NTIS, PC A02/MF A01.

The principal research accomplishment during the period of the grant was the study of generation of acoustic pulses from electromagnetic pulses. In particular, the authors considered an infinite medium, which the authors took to be a non-conducting liquid (ultimately we chose water for numerical examples) and assumed that a one-dimensional and electromagnetic pulse or train of pulses was created at time t=O by the turning on and off of appropriate currents and found the acoustic pulses which were generated by the electromagnetic pulses. Indications are that if the electromagnetic pulse is sufficiently strong, the acoustic pulse which is generated can have significant physiological effects, if the liquid, say water, is assumed to model a tissue. The authors have also investigated the mathematics of the Radon transform with the view to using it to obtain the exact time-dependent acoustic and electromagnetic fields from the fields in the wave zone. The applications are many, but the use in aerospace medicine includes the monitoring of acoustic and electromagnetic fields at a distance from the source and determining the fields near the source. Another area of research has been the time-dependent propagation of one-dimensional electromagnetic pulses through slabs and media with continuously varying index of refraction, possibly with jumps.

1989 **(AD-A—182890/4/XAB) Biological effects of millimeter-wave irradiation. Final report, 15 April 1984-31 March 1986.** Gandhi, O.P.; Hill, D.W.; Furia, L.; Iskander, M.F.; Ghodgaonkar, D. (Utah Univ., Salt Lake City (USA). Dept. of Electrical Engineering). Apr 1987. 93p. (UTEC—86-095). NTIS, PC A05/MF A01.

Experiments were conducted to verify the reported high degree of sensitivity of growth rates of yeast cultures to frequency of millimeter-wave irradiation in the band 41.650 to 41.798 GHz. A new irradiation chamber was designed and built to allow simultaneous irradiation and sham irradiation of recirculating suspension of Saccharomyces cerevisiae that were maintained with a temperature difference of less than 0.01 C. No difference larger than plus or minus 4% was ever detected in the growth rates at any of the highly stabilized (within plus or minus 50 Hz) irradiation frequencies for which the effects had been reported by earlier workers. Experiments were also performed to determine the Raman spectra of cultures of Bacillus megaterium to investigate if these are dependent on the stage of their life cycle as reported by Webb et al. The results were negative. A further study to investigate the ability of millimeter waves to induce conformational changes in lipid bilayers of dipalmitoylphosphatidycholine (DPPC) liposomes below and above the transition temperature of 41°C also gave negative results. For these experiments the conformational characteristics of the liposomes were evaluated using Raman spectra with and without millimeter-wave irradiation at 41.650 GHz.

1990 **(AD-A—183055/3/XAB) Interruption of neural function. Final report, April 1981-May 1985.** Wachtel, H. (Colorado Univ., Boulder (USA). Dept. of Electrical and Computer Engineering). May 1987. 51p. NTIS, PC A04/MF A01.

Wide microwave pulses (1 to 10 milliseconds long) and pulse trains were applied to a variety of neural preparations including molluscan ganglia, isolated rat brain slices and intact mouse brain. While different forms of effect were observed in each case, a dependence on the associated temperature rate of rise appears to be the underlying factor in all cases. Although temperature rise rates were significant, total temperature elevations were minimal and of a nondestractive nature. The neural modulatory effects seen may thus prove to be useful as a noninvasive means of inputting information into the brain.

1991 **(LIS—67) Points to noise emission forecasts within the framework of licensing procedures according to the Federal Pollution Law.** Assmann, J. (Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.)). 1986. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87770293/JAW.

Before constructing new plants proof must be presented that no harmful effects caused among others by noise ensue for the neighborhood. Any application for a plant operating license must include data on the environmental effects. If necessary the resultant ambient noise levels must be predicted. However, no instructions exist concerning the prediction method to be used. Although a largely standardized prediction method for noise levels evolved, there are open questions concerning details. The report explains the basic principles of noise level predictions and contains instructions on examining presented calculations. It is attempted to standardize the examination process of noise forecasts submitted for obtaining plant operation licenses. (orig./HSCH).

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 397, 1098, 1099

1992 **(NP—7900976) Injury experience in stone mining, 1985.** (Mine Safety and Health Administration, Denver, CO (USA). Safety and Health Technology Center). 1987. 445p. (IR—1187). NTIS, PC A19. Order Number DE87900976/JAW.

This Mine Safety and Health Administration (MSHA) informational report reviews in detail the occupational injury and illness experience of stone mining in the United States for 1985. Data reported by operators of mining establishments concerning work injuries are summarized by work location, accident classification, part of body injured, nature of injury, occupation, and principal type of mineral. Related information on employment, worktime, and operating activity also is presented. Data reported by independent contractors performing certain work at mining locations are depicted separately in this report. For ease of comparison with other metal and nonmetallic mineral mining industries and with coal mining, summary reference tabulations are included at the end of both the operator and the contractor sections of this report. 22 tabs.

1993 **(NP—7900977) Injury experience in nonmetallic mineral mining (except stone and coal), 1985.** (Mine Safety and Health Administration, Denver, CO (USA). Safety and Health Technology Center). 1987. 298p. (IR—1186). NTIS, PC A13. Order Number DE87900977/JAW.

This Mine Safety and Health Administration (MSHA) informational report reviews in detail the occupational injury and illness experience of nonmetallic mineral mining (except stone and coal) in the United States for 1985. Data reported by operators of mining establishments concerning work injuries are summarized by work location, accident classification, part of body injured, nature of injury, occupation, and principal type of mineral. Related information on employment, worktime, and operating activity also is presented. Data reported by independent contractors performing certain work at mining locations are depicted separately in this report. For ease of comparison with other metal and nonmetallic mineral mining industries and with coal mining, summary reference tabulations are included at the end of both the operator and the contractor sections of this report. 22 tabs.

58 GEOSCIENCES

1994 **(DOE/ER—0349) Summaries of physical research in the geosciences.** (USDOE Office of Energy Research, Washington, DC. Engineering and Geosciences Div.). Sep 1987. 133p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88000833/JAW.

The Department of Energy supports research in the geosciences in order to provide a sound foundation of fundamental knowledge in those areas that are germane to the Department of Energy's many missions. The summaries in this document, prepared by the investigators, describe the scope of the individual programs. The Geoscience Research Program includes research in geology, petrology, geophysics, geochemistry, solar-terrestrial relationships, aeronomy, seismology, and natural resource analysis, including their various subdivisions and interdisciplinary areas. All such research is related either directly or indirectly to the Department of Energy's technological needs.

1995 **(LBL—22090) Earth Sciences Division: Annual report, 1986.** (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 261p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88000685/JAW.

Research is reported in the following fields: reservoir engineering and hydrogeology, geochemistry, geomechanics, and geophysics. (DLC)

1996 **(UCRL—53615-86) Earth sciences annual report, 1986.** Wang, H.F.; Donohue, M.L.; Peterson, S.J.; Stull, S.P. (eds.). (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000821/JAW.

The Earth Sciences Department at the Lawrence Livermore National Laboratory is organized into ten groups. Four of these - Nuclear Waste Management, Fossil Energy, Containment, and Verification - represent major programmatic activities within the Department. Five others - Experimental Geophysics, Geomechanics, Geology/Geological Engineering, Geochemistry, and Seismology/Applied Geophysics - are major disciplinary areas that support these and other Laboratory programs. The Research Group develops new capabilities, such as fluid-flow modeling, and promotes long-range research into concepts that may help meet the national needs of the future. This report summarizes work carried out in

1986 by each group and contains a bibliography of 1986 publications. Separate abstracts have been prepared for activity area.

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 112, 239, 389, 1529, 1671, 1796

1997 **(ANU-P—980) Chlorine-36 dating program at the Australian National University.** Fifield, L.F.; Ophel, T.R.; Bird, J.R.; Calf, G.E.; Allison, G.B.; Chivas, A.R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). May 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700098/JAW.

A chlorine-36 dating capability based on the 14UD pelletron accelerator was developed at the Australian National University during 1986 and is now entering the routine measurement phase. It involves a collaboration between the Department of Nuclear Physics, the Australian Atomic Energy Commission and CSIRO Division of Soils. The chlorine-36 dating system is described and some early results are presented for samples of chloride from salt lakes in Western Australia and soil profiles in South Australia.

1998 **(NAGRA-NTB—82-10) Exploratory borehole Weiach. Working programme.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1982. 101p. (In German). Nagra, CH-5401 Baden, Switzerland.

An extensive geophysical borehole logging programme will serve to verify the results of the core analysis and comlement the core data. Numerous borehole logs are to be registered with different types of tools. These allow one to determine various parameters essential for the full description of the rock sequences penetrated. A first category of logs enables the petrographical identification of the different rock types and indicates porous zones that are either water- or hydrocarbon bearing. A second category provides data e.g. on the degree of pore and fracture fill, rock density and rock temperature, natural gamma radiation and rock-mechanical properties. Other logs measure strike and dip of the sedimentary layers and the position of rock fractures. A fourth category provides information on the diameter and the deviation of the borehole, the quality of casing cementations and the position of casing joints. In addition, well shooting surveys will supply exact values of seismic velocities for the various rock units; data that are needed for the depth correction of the reflection profiles from Nagra's regional seismic network. With numerous hydrological tests ranging from an open-hole production test of the Muschelkalk aquifer to labelled slug tests in low-permeability crystalline sections, the hydraulic conditions of deep groundwater flow will be investigated. The recovered water samples will undergo full physical and geochemical analysis. Furthermore, their isotope content is to be measured in order to estimate the age of the various formation waters. To round off the scientific investigations, a series of rock-mechanical and geotechnical laboratory tests will provide characteristic values to be applied eventually in the design and construction of shafts and caverns for an underground repository.

1999 **(NAGRA-NTB—82-12) Stripa Project. Annual report 1981.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Feb 1982. 31p. Nagra, CH-5401 Baden, Switzerland.

This annual report is prepared by the Project Manager in accordance with Article 2, Paragraph 8, and Article 7, Paragraph 5 of the Stripa Project Agreement. The aim is to inform the OECD Nuclear Energy Agency Committee on Radioactive Waste Management and its Coordinating Group on Radioactive Waste Disposal into Geologic Formations as well as the Participants in the Project about the general progress of work during 1981.

2000 **(NAGRA-NTB—83-25) Exploratory borehole Schafisheim. Programme of work .** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1983. 103p. (In German). Nagra, CH-5401 Baden, Switzerland.

An extensive geophysical borehole logging programme will serve to verify the results of the core analysis and complement the core data. Numerous borehole logs are to be registered with different types of tools. These allow one to determine various parameters essential for the full description of the rock sequences penetrated. A first category of logs enables the petrographical identification of the different rock types and indicates porous zones that are either water- or hydrocarbon-bearing. A second category provides data e.g. on the degree of pore and fracture fill, rock density and rock temperature, natural gamma radiation and rock-mechanical properties. Other logs measure strike and dip of the sedimentary layers and the position of rock fractures. A fourth category provides information on the diameter and the deviation of the borehole, the quality of casing cementations and the position of casing joints. In addition, well shooting surveys will supply exact values of seismic velocities for the various rock units; data that are needed for the depth correction of the reflection profiles from Nagra's regional seismic network. With numerous hydrological tests ranging from a production tests of the triassic Muschelkalk aquifer to labelled slug tests in low-permeability crystalline sections, the hydraulic conditions of deep groundwater flow will be investigated. The recovered water samples will undergo full physical and geochemical analysis. Furthermore, their isotope content is to be measured in order to estimate the age of the various formation waters and their time of residence in the various aquifers. To round off the scientific investigations, a series of rock-mechanical and geotechnical laboratory tests will provide characteristic values to be applied eventually in the design and construction of shafts and caverns for an underground repository.

5802 Geophysics

REFER ALSO TO CITATION(S) 244, 294, 371, 372, 579, 901, 902, 903, 904, 905, 906

2001 **(AD-A—182752/6/XAB) Effects of heterogeneities on the propagation, scattering and attenuation of seismic waves and the characterization of seismic source. Final report, 1 December 1982-30 November 1985.** Aki, K.; Cormier, V.F.; Toksoz, M.N. (Massachusetts Inst. of Tech., Cambridge (USA). Earth Resources Lab.). 1985. 271p. NTIS, PC A12/MF A01.

During this reporting period, work was completed on testing alternative measures of body-wave magnitude. It was found that alternative measures of body waves magnitude often exhibit as much scatter as classical measures of magnitude, although coda magnitudes usually have slightly less scatter than spectral and classical magnitudes. In the cases investigated, these differences were usually not statistically significant. Another completed task was an investigation of the intrinsic attenuation of the Earth's mantle selected paths from the Sea of Okhotak to Regional Seismic Test Network (RSTN) and Global Digital Seismic Network (GDSN) Stations in North America. It was concluded that the intrinsic attenuation in the mantle beneath eastern North America is both depth and frequency dependent and that spectral and time domain studies of attenuation can be reconciled in the frequency band up to 2 Hz. The focus of the project was then divided between source problems related to scattering and seismic wave propagation in three-dimensional, heterogeneous media. A significant result was that short period and broadband waveforms can improve the depth-resolution-determined earthquakes and underground nuclear explosions, forming a powerful discriminant. Scattering was studied theoretically and observationally. The significant result of that work is that the Earth's lithosphere must possess multiple scales of heterogeneity in order to explain both the amplitude and phase fluctuations at large arrays as well as the shapes of local S coda.

2002 **(AD-A—182912/6/XAB) Subsurface investigation of a liquefaction-induced lateral spread, Thousand Springs Valley, Idaho. Final report.** Andrus, R.D.; Youd, T.L. (Brigham Young Univ., Provo, UT (USA). Dept. of Civil Engineering). May 1987. 132p. NTIS, PC A07/MF A01.

A subsurface investigation was made across a lateral spread that was induced by liquefaction during the 1983 Borah Peak Earthquake (MS=7.3). The lateral spread is at a site near Whiskey Springs in the Thousand Springs Valley, Idaho. The purpose of the investigation was to (a) determine whether previous liquefaction

and lateral spreading had occurred; (b) measure and evaluate geologic and geotechnical properties susbsurface sediments many of which are gravels; and (c) analyze liquefaction and ground failure susceptibility. Because there are very few past case histories of liquefaction in gravel, this study provides an opportunity to further evaluate the behavior of this important matarial. The field investigations included trenching, SPT tests, CPT soundings, BDT (Becker Drill) tests, and SASW tests (Spectral-Analysis-of Surface-Waves). Radiocarbon dataing and grain-size analysis were conducted on samples collected in the field.

2003 (AD-A—182930/8/XAB) **Assessment of excitation mechanisms and temporal dependencies of infrared radiation from vibrationally excited carbon monoxide and ozone in EXCEDE experiments. Technical report, January 1983-November 1984.** Kolb, C.E.; Zahniser, M.S.; Lyons, R.B. (Utah State Univ., Logan (USA). Center for Space Engineering). 31 Mar 1987. 53p. (CSE—87-016). NTIS, PC A04/MF A01.

A goal of the EXCEDE artificial aurora experiment is to quantify upper atmospheric infrared emission mechanisms for disturbed atmospheric conditions. In this report sources and vibrational excitation mechanisms relevant to electron bean induced infrared emission from carbon monoxide and ozone in the 90-130 km altitude range are reviewed and assessed. Estimates of vibrational excitation deposition fractions ratioed to the ion-pair creation energy-deposition level are presented along with predicted energy deposition and decay rates for each mechanism. Mechanisms considered for CO(v) production include direct electron impact on ambient CO, dissociative excitation of Carbon dioxide, V-V exchange with vibrationally excited Diatomic nitrogen, Diatomic oxygen, and Oxygen, and infrared chemiluminescence from the reaction of CO_2 with O(+). The conclusions are that the initial production of CO(v) is dominated by direct electron impact on ambient CO which represents a fraction of .000045 of the ion pair production energy at 100 km altitude and decays with a radiative time constant of 28.3 ms. On a longer time scale of 0.1 to 100 s after electron beam termination, energy transfer from N_2(A) and the O_2(A',c) metastable states and from vibrationally excited N2(v) may contribute to CO(v) production. Potentially the strongest production mechanisms for vibrationally excited O_3 are the two body reactions of O_2(A, A',c) metastable states with ambient O_2.

2004 (IAEA-RL—139, pp 1-29) **Field trials of borehole logging methods at the Groote Eylandt Mine: Determination of the Mn grade of the ore by prompt neutron-gamma and gamma-gamma logging.** Aylmer, J.A.; Ceravolo, C.; Charbucinski, J.; Eisler, P.L.; Youl, S.F. (Commonwealth Scientific and Industrial Research Organization, Port Melbourne, Australia. Div. of Mineral Engineering). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

Prompt neutron-gamma and gamma-gamma logging methods were field tested at the manganese mine of the Groote Eylandt Mining Company. The prompt neutron-gamma method has potential for quantitative grade estimation. The accuracy of calibration for the whole mine, represented by the r.m.s. deviation between probe response and chemical assays of drill cuttings was 2.9% Mn for ore-grade material (%Mn > 25%) and 4% Mn for all mineralised material (%Mn > 10). The accuracy was only slightly improved by calibrating the probes in individual deposits of the mine. The gamma-gamma method tested was only semi-quantitative for determining Mn grades for the whole mine area, where the accuracies of calibration were 5.2% Mn and 6.6% Mn for the ore-grade and the mineralised materials respectively. The calibration obtained in the A and D deposits, albeit with a limited set of data, gave an accuracy of 2.5% Mn indicating that further investigation is desirable to establish the quantitative scope of the method. 14 refs, 10 figs, 5 tabs.

2005 (IAEA-RL—139, pp 31-44) **Development of gamma-gamma borehole logging probes for quantitative determination of atomic number of mineral deposit, and for use in small diameter boreholes. Final report.** Aylmer, J.; Borsaru, M.; Charbucinski, J.; Eisler, P.; Huppert, P.; Indrans, A.; Youl, S. (Commonwealth Scientific and Industrial Research Organization, Port Melbourne, Australia. Div. of Mineral Engineering). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

The borehole logging group of the CSIRO Division of Mineral Engineering have successfully developed and tested a borehole logging system based on the spectrometric gamma-gamma method. The system was tested in coal, iron ore and manganese deposits. Prototype and commercial equipment were designed and constructed. Commercialization of the system is in progress through collaboration with the mining industry, and through licensing agreements. The probes were specially designed for satisfactory operation in narrow boreholes. 5 refs, 3 figs, 1 tab.

2006 (IAEA-RL—139, pp 45-51) **Field trials of borehole logging probes for density determinations in low-grade ore deposits.** Borsaru, M.; Ceravolo, C.; Charbucinski, J.; Eisler, P.L. 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

Borehole logging probes designed for measuring rock densities in low-grade copper deposits were tested at the Bougainville open-cut mine in both blast holes and diamond-core drilled holes that were shallow, rough-walled and drained of fluids. The method, based on both the density and the diameter-sensitive S-factor responses, gave measurements that were insensitive to borehole diameter variations. Although radiation safety indicated the use of an only moderately strong source of primary radiation (50 MBq /sup 60/Co) for these operations, good precision was achieved for 2 m strata, namely 0.035 g cm/sup -3/ in blast holes and 0.016 g cm/sup -3/ in diamond-core drilled holes where the mean density of the rocks was about 2.6 g cm/sup -3/. The corresponding accuracy of about 0.05 g cm/sup -3/, obtained in both types of boreholes, was apparently limited by the geostatistical variability of the rock density. 5 refs, 4 figs, 2 tabs.

2007 (IAEA-RL—139, pp 113-152) **Simulated borehole logging of Egyptian Hematite and Monazite ores using high resolution gamma-ray spectroscopy.** Hussein, A.Z.; Rofail, N.B.; Soliman, N.F. (Atomic Energy Authority, Cairo, Egypt. Reactor and Neutron Physics Dept.). 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700177/JAW. (CONF-8611195—).

From Final research co-ordination meeting on nuclear analytical techniques for mineral exploration, mining and processing plants; Melbourne, Australia (3 Nov 1986).

In this work a presentation is given for the elemental analysis through neutron induced activation of the domestic Hematite and Monazite (black sand) ores as well as the effective ore depth (cross-over region) of a borehole simulation. Ores' bulk-media assay has been carried out using borehole probe (sonde) which was designed and constructed to work within an ore containment. This borehole sonde model is made of an aluminium casing of 70 cm in length and 12 cm inner diameter to accomodate isotopic neutron sources, radiation shadow shield and a detector. The assembly was assessed to permit high gamma-ray sensitivity, low interference and minimum radiation damage to Ge detectors. The bulk ore containment consists of a number of coaxially nested tubes made of suitable steel material. This containment has been constructed to suit the purpose of the present study. Results of the neutron capture gamma-ray spectra from the ores and their analysis are presented. Computed data of the effective depth of the ores are interpreted. Moreover, quantitative analysis has been carried out for some of the rare earth elements of the Monazite ore. 10 refs, 9 figs, 1 tab.

2008 **(IFP—34-728) Space-frequency analysis of wave train in mono or multi-component seismics.** Berriani, B. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison). Nov 1986. 175p. (In French). NTIS (US Sales Only), PC A08. Order Number DE88750275/JAW.

On short time-window, we assume that the seismic signal results from a superposition of damped frequencies propagating along distinctive directions (generalised Lissajous curves). The "Rotating-Axis" method here developed, consits in analysing frequencies of the trace observed from different directions. This analysis is done over short time-windows and autoregressive (AR) methods are used. The study of the energy of each frequency component and the Filter Prediction Error (FPE) at each step of rotation allows to estimate the direction of polarization of each frequency. The determination of the generalised Lissajous parameters allows to construct a mathematical model valid over short time-window. By sliding this window along the trace (time), we obtain an evolutionary model along the trace. By retaining, in the model, only the frequencies we wish to keep, we reject the other undesirable frequencies, and we reconstruct the signal.

2009 **(IFP—34-775) Evaluation of seismic attenuation measurements from vertical seismic profile registered data.** Petit, M.J. (Institut Francais du Petrole (IFP), 92 - Reuil-Malmaison). Jul 1986. 287p. (In French). NTIS (US Sales Only), PC A13. Order Number DE88750276/JAW.

This work is aimed at looking for a possibility of attenuation measurement from seismic data, then at the estimation of the basic element perturbing possibly this measurement and consequently limiting it. So principles and interest of vertical seismic profile together with attenuation parameter definition are recalled. A bibliographic study is developed to compare from numerous works on seismic recordings and rock samples to compare the different methodologies and to show off the main difficulties encountered and the possible solutions. A calculation of synthetic vertical seismic profile is defined, taking in account the seismic wave attenuation. The simulation study allows to find the validity limits of the measurement method of attenuation and so to connect the estimation to the recording conditions, geophysical processes and geological interpretation. A vertical seismic profile recorded on Gournay-sur-Aronde site in 1982 is studied taking in account the limits found. Then a methodoly possible to study the seismic wave attenuation phenomena from the well seismic records is given.

2010 **(LBL—23544) A new approach to modeling and interpreting electromagnetic sounding data.** Lee, K.H. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 14p. (CONF-871164—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000460/JAW.

From Mexican Geophysical Union conference; Ensenada, Mexico (10 Nov 1987).

A major impediment to the application and acceptance of controlled-source electromagnetics has been the difficulty of processing, displaying, and intepreting the data. Our goal has been to develop a method for imaging the subsurface conductivity distribution. We have sought a representation that would provide some direct visualization of the subsurface conductivity contrasts that give rise to the observed or calculated fields. We have discovered a new method for calculating the electromagnetic response of inhomogeneous conducting media that is not only computationally efficient but promises to provide the inverse solutions we have long sought. The method can be used to: (1) model em problems (the forward solution) with a speed at least two orders of magnitude faster than conventional methods; and (2) provide reflectivity images of subsurface conductivity contrasts similar to those obtained in reflection seismic methods.

2011 **(NAGRA-NTB—83-21) Geophysical investigation programme Northern Switzerland. Regional seismic refraction measurements .** Sierro, N.; Bindschaedler, A.; Ansorge, J.; Mueller, St. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Sep 1983. 71p. (In German). Nagra, CH-5401 Baden, Switzerland.

In the framework of the geophysical survey of Switzerland the depth to the basement under the northeastern parts of the Swiss Jura mountains was determined by means of the seismic refraction method. This included an assessment of the seismic velocities within this crystalline basement at depth as well as for its outcrop in the nearby southern part of the Black Forest. The Swiss Geophysical Commission (SGPK) and the National Cooperative for the Storage of Radioactive Waste (NAGRA) were joint sponsors of this survey. The Institute of Geophysics of the Swiss Federal Institute of Technology in Zurich (ETH-Z) organized the fieldwork and performed the interpretation of the data. On a contour map covering the area of the northeastern Jura and the adjacent fringe of the Molasse basin the basement dips down to the south-southeast under the Mosozoic and Cenozoic sediments. This dip is more pronounced under the tabular Jura mountains and east of the Aare river than further south where the relief flattens out considerably. Pronounced east-west striking variations overlie the general southward oriented slope. Two small scale troughs seem to exist near Moenthal and Frick west of the Aare valley. To the east of the Aare valley the crystalline basement forms a regional trough with a maximum depth of 2100 m below mean sea level. This unexpectedly large trough is likely to be filled with Permo-Carboniferous sediments. The eastern ranges of the folded Jura mountains again are underlain by a depression in the basement which is much less marked, however. To the south of this area, between Wildegg and Mellingen, a relative high of 200 m is superimposed on the generally SSE dipping basement. The unexpected low velocities of the upper basement indicate severe weathering. Possibly the uppermost rocks are altered to such a degree that the location of the top of the basement is relatively inaccurate.

5803 Mineralogy, Petrology, And Rock Mechanics

2012 **(NP—8900091) Petrophysical log interpretation of tight gas sands: Final report, 1985-1986.** Tsay, F.S.; Fang, J.H. (Alabama Univ., University (USA). School of Mines and Energy Development). Jun 1987. 64p. School of Mines and Energy Development, Box 6282, University of Alabama, Tuscaloosa, AL 35486 . Order Number TI88900091/JAW.

In tight-gas sands, clay minerals are detrimental to the accurate evaluation of porosity, permeability, and water saturation derived from well logs. In this study, the effects of individual clay minerals on these petrophysical properties are examined. Sixty-five samples were randomly chosen from the cored interval, 9374 to 9811 feet in depth in Amoco's Joe S. Kinsey No. 1 well of the dirgin Field in Rusk County, Texas. Samples include both shaly and sandy units of tight, delta-front sandstones of the Cotton Valley Group. Mineralogy of these samples was determined by x-ray analysis. Petrophysical properties were determined for each sample depth. The relationships between clay-mineral weight percentages and petrophysical properties were determined by analysis of simple correlation coefficients and canonical variable weights. Results show that water-sensitive clay minerals (illite and mixed-layer illite/smectite) are more effective in altering petrophysical properties derived from well-log responses than non-water-sensitive clay minerals (kaolinite and chlorite). This occurs because water-sensitive clay minerals have more bound water, larger surface areas, and higher cation exchange capacities. Porosity is affected by clay mineralogy. Log-derived porosities are increased by the presence of water associated with water-sensitive clay minerals. Bound water and water in micropores of water sensitive clay minerals increase the concentration of hydrogen ions, decrease bulk density, and increase acoustic transit time. Permeability is probably reduced preferentially by some clay minerals. However, the inaccuracy of laboratory measurements of permeability prevents these relationships from being revealed. Water saturation calculations are affected by clay minerals. Archie's water saturation is high because it does not account for the resistivity-reducing effects of water-sensitive clay minerals. 21 refs., 11 figs., 24 tabs.

5804 Geochemistry

REFER ALSO TO CITATION(S) 266, 1830

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 1197, 1322, 1403, 1611, 1638, 1639, 2142, 2170, 2191, 2293, 2333, 2516

2013 **(CEA-CONF—8821) Scaling laws for evaporative supernovae remnants in the McKee and Ostriker theory of the interstellar medium.** Chieze, J.P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jul 1986. 8p. (CONF-8606145—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752746/JAW.

From 26. Committee on Space Research meeting; Toulouse, France (30 Jun 1986).

The theory of the Interstellar Medium proposed by McKee and Ostriker is dominated by the unusual properties of evaporative supernovae remnants (ESNR). We present here the basic features of this model, with emphasis upon: (i) the evolution of supernovae remnants in an inhomogeneous evaporative medium, (ii) the collective effects of such ESNRs upon the structure of the interstellar medium. Following McKee and Ostriker, we will derive the time dependent evolution of evaporative supernovae remnants, then determine the conditions for percolation and finally identify the mean physical properties of the medium with the mean properties inside ESNRs at percolation.

2014 **(CEA-CONF—8855) Primordial nucleosynthesis and chemical evolution of galaxies.** Audouze, J.; Delbourgo-Salvador, P.; Vangioni-Flam, E. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jul 1986. 7p. (CONF-860793—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752905/JAW.

From 2. IAP meeting on nuclear astrophysics; Paris, France (7 Jul 1986).

Simple or canonical Big Bang models are claimed to account properly for the abundances of the lightest elements D, ^{3}He, ^{4}He and ^{7}Li if the baryonic cosmological parameter of the Universe is $\Omega/\text{sub B} < 0.1$ and if the maximum number of neutrino families is 3. Agreement between the predictions of such models and the primordial abundances deduced from observations is not as compelling or striking as the proponents of such a simple (and therefore beautiful) hypothesis would like. In order to reconcile these simple models with the observations we argue that the galactic evolution should be such that a significant fraction of D has to be destroyed during the history of the Galaxy. As a consequence the resulting $\Omega/\text{sub B}$ is lower than 0.06 i.e. significantly smaller than in the simplest framework. Moreover this hypothesis of significant D destruction during the galactic evolution could be observationally tested.

2015 (ESA-SP—250-VOL-2, pp 3) **Thermal infrared imaging of Comet Halley.** Campins, H.; Telesco, C.M.; Decher, R.; Ramsey, B.D. (Planetary Science Institute, Tucson, AZ). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Thermal infrared images (10.8, 12.8, and 19.2 microns) of comet Halley were obtained on 1986 Mar. 28.7, 29.7 and 30.7 UT using the NASA-MSFC 20-pixel bolometer array at the NASA Infrared Telescope Facility. Analysis of the observations shows: the presence of spatial structure indicative of dust ejection occurring mainly on the sunward side of the nucleus; a dust coma deficient in large particles (radius greater than 100 microns) compared with that of Comet P/Giacobini-Zinner, temporal variability consistent with an extrapolation of a quasi-sinusoidal light curve observed by IUE on 1986 March 23, 24, and 25; and a maximum at the nuclear condensation of the color temperature and the strength of the silicate emission feature.

2016 (ESA-SP—250-VOL-2, pp vp) **Infrared temporal development of P/Halley.** Gehrz, R.D.; Ney, E.P. Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Halley's comet was observed at 0.7 to 23 microns with several diaphragms and beam throws on over 30 occasions between 1985 Dec. 12 and 1986 May 6. Several times, once within hours of perihelion, simultaneous measurements were made with different beam sizes using telescopes in Minnesota and Wyoming. Halley has an average dust albedo of 12% at 120 deg scattering angle. There is no evidence for strong backscattering in the phase function to angles of 165 deg. The 10 microns silicate signature is always present but varies in strength for heliocentric distances less than 1 AU. It is absent at distances greater than 1 AU. The dust albedo appears to decrease when the silicate feature is weak. Halley's infrared intensity fluctuates by a factor of 7 on timescales of 1 to 2 days. The variations suggest jet-like activity associated with nuclear rotation.

2017 (ESA-SP—250-VOL-2, pp 3) **Airborne photometry of Comet Halley from 40 to 160 microns.** Campins, H.; Joy, M.; Harvey, P.M.; Lester, D.F.; Ellis, H.B. Jr. (Texas Univ., Austin). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Far infrared photometry of comet Halley was obtained from NASA's Kuiper Airborne Observatory. The brightness of the comet decreases by nearly a factor of two on the second day in phase with the variability observed in blue light by IUE during the same time period. The energy distribution also varies significantly with a shallower (cooler) spectrum on the second day indicating fewer small particles on that day. Observations 30 and 60 arcsec away from the nuclear condensation show lower 50 to 100 microns color temperatures on both dates. This is consistent with observations by Giotto and Vega which indicate a higher proportion of large particles away from the nucleus.

2018 (ESA-SP—250-VOL-2, pp 6) **Airborne spectrophotometry of P/Halley from 20 to 65 microns.** Glaccum, W.; Moseley, S.H.; Campins, H.; Loewenstein, R.F. (Chicago Univ., IL). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Simultaneous 20 to 65 microns spectrometry and 100 microns photometry of P/Halley obtained on board the Kuiper Airborne Observatory (KAO) in 1985 Dec. and 1986 April are discussed. Spectra with resolution 30 to 50 were obtained with the NASA/Goddard 24 channel grating spectrometer. Measurements were made on the nucleus as well as 5 points along and perpendicular to the Sun-tail direction. The observations reveal the absence of any strong spectral features. The color temperature of the dust varies over time scales as short as 2 days, but is higher than that expected for a rapidly rotating blackbody at the same distance from the Sun. The color temperature does not vary within 1 arcmin of the nucleus, but the coma is brighter on the sunward side than on the antisunward side.

2019 (ESA-SP—250-VOL-2, pp 4) **Airborne spectrophotometry of P/Halley from 16 to 30 microns.** Herter, T.; Gull, G.E.; Campins, H. (Planetary Science Institute, Tucson, AZ). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Comet Halley was observed in the 16 to 30 micron region using the Cornell University 7-channel spectrometer (resolution = 0.02) on board the Kuiper Airborne Observatory on 1985 Dec. 14.2. A 30-arcsec aperture (FWHM) was used. Measurements cen-

tered on the nuclear condensation micron indicate that if present, the 20 micron silicate feature is very weak, and that a relatively narrow strong feature centered at 28.4 microns possibly exists. However, this feature may be an artifact of incomplete correction for telluric water vapor absorption.

2020 (ESA-SP—250-VOL-2, pp 4) **Airborne spectrophotometry of Comet Halley from 5 to 9 microns.** Campins, H.; Bregman, J.D.; Witteborn, F.C.; Wooden, D.H.; Rank, D.M.; Allamandola, L.J.; Cohen, M.; Tielens, A.G.G.M. (California Univ., Berkeley). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Spectrophotometry from 5 to 9 microns (resolution = 0.02) of comet Halley was obtained from the Kuiper Airborne Observatory on 1985 Dec. 12.1 and 1986 April 8.6 and 10.5 UT. Two spectral features are apparent in all the observations, one from 5.24 to 5.6 microns, and the silicate emission feature which has an onset between 7 and 8 microns. There is no evidence for the 7.5 microns feature observed by the Vega 1 spacecraft; the large difference between the areal coverage viewed from the spacecraft and the airplane may explain the discrepancy. Color temperatures significantly higher than a blackbody indicate that small particles are abundant in the coma. Significant spatial and temporal variations in the spectrum show trends similar to those observed from the ground.

2021 (ESA-SP—250-VOL-2, pp 4) **Multiple aperture airborne infrared measurements of Comet Halley.** Russell, R.W.; Lynch, D.K.; Rudy, R.J.; Rossano, G.S.; Hackwell, J.A.; Campins, H.C. (Planetary Science Institute, Tucson, AZ). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Observations at 10 microns with a 3.5′ diameter beam made from the NASA Lear Jet Observatory during April 7.6 to 11.6, 1986 UT are presented. Data show evidence for a dramatic outburst (factor of 3 in 10 micron flux) with a turn-on time of 1 day and turn-off time of 1 to 2 days. Total mass ejected in the outburst is estimated. When combined with 8 and 10 microns data taken by Campins et al the dependence of the dust density on distance from the nucleus can be evaluated. It is shown that the flux within an aperture of diameter D is directly proportional to D well beyond 60″ (2 million m at the comet). At 64 million m diameter (210″), the measurements are only 30% below the level expected for a strict F varies as d dependence. This, combined with the time scales of the event, places constraints on processes of grain destruction. The energy of the outburst is derived and compared to solar heating.

2022 (ESA-SP—250-VOL-2, pp 13) **Dust environment of Comet Halley.** Sekanina, Z. Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Advances in the understanding of comet Halley's dust environment are highlighted. Spacecraft results on the dust composition, the detection of subfemtogram grains, and the particle-mass distribution; jets and the dust-emission pattern; the existence of discrete sources on the nucleus surface and the determination of their locations from day-to-day motions of coma features; CN jets; large-scale phenomena, including an antitail, streamers, and a sunward spike; infrared observations, such as the 3.4 microns emission feature, applications of array detectors, and rare far-infrared data; the chemical modification of low-temperature ices by UV and cosmic-ray irradiation processes, their laboratory simulations, and applications to the evolution of comets; the interstellar-connection models of comet origin; and the formation of a mantle made of refractory organic material on the nucleus surface.

2023 (ESA-SP—250-VOL-2, pp 6) **Comet Halley near-nucleus phenomena in 1986.** Larson, S.; Sekanina, Z.; Levy, D.; Tapia, S.; Senay, M. (Orange Free State Univ., Bloemfontein, South Africa). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Computer enhanced high resolution groundbased images taken during Halley's most active phases in 1985-86 exhibit all of the coma structures identified in 1910 photographs. The structures result mostly from discrete dust jet activity producing spirals, arcs, and jagged-edged envelopes. Multiple nucleus and antisunward jet phenomena are also observed. The curvature of the jets is consistent with the location of the Earth with respect to the nucleus equatorial plane. The variation in jet activity during the Vega and Giotto flybys is easily seen on the groundbased images. Images of CN jets show that they usually do not correlate with dust jets. Wide field, medium resolution images of faint outer envelopes are required to augment the smaller field, high resolution images of near-nucleus jets in modeling the jets.

2024 (ESA-SP—250-VOL-2, pp 5) **Sunward spike and equatorial plane of Halley's Comet.** Sekanina, Z.; Larson, S.M.; Emerson, G.; Helin, E.F.; Schmidt, R.E. (Naval Observatory, Washington, DC). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Photographs from late April until at least early June 1986 of comet Halley show a narrow spike in the Sun's direction. It extends to distances of at least 700,000 km from the nucleus in projection onto the sky on computer processed photographs. The spike is composed of dust and its enormous sunward extent (compared to other dust features) suggests an anomalously high ratio of particle ejection velocity to solar radiation pressure. The implied grains are either dielectric or slightly absorbing and much less than 1 micron in size, which are undetectable optically, unless Earth is located in or very near a plane of their concentration. The only plane to which these grains can possibly be confined for long is the equatorial plane of the nucleus, especially when the obliquity is small. Accordingly, the spike's position as a function of time contains information on the comet's spin axis.

2025 (ESA-SP—250-VOL-2, pp 6) **Mass distribution of particulates measured by Giotto's Dust Impact Detection System (DIDSY) in the close encounter period.** Zarnecki, J.C.; Mcdonnell, J.A.M.; Burton, W.M.; Alexander, W.M.; Hanner, M.S. (Baylor Univ., Waco, TX). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

The cumulative mass distribution of the comet Halley dust efflux in the close encounter period -300 to +300 sec was analyzed. Analysis of the cumulative mass distribution index (alpha) shows considerable short time scale variation. There is clear evidence from the flux rates of passage through at least one major dust enhancement (dust jet) just after closest approach and this is associated with a steepening of the alpha. Comparison with measurements from other sources, and with preencounter predictions, is also made.

2026 (ESA-SP—250-VOL-2, pp 4) **Dust distribution of Comet Halley from the Giotto radio science experiment.** Edenhofer, P.; Buschert, H.; Porsche, H.; Bird, M.K.; Volland, H.; Brenkle, J.P.; Kursinsky, E.R.; Mottinger, N.A.; Stelzried, C.T. (Bonn Univ., West Germany). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Measurements from the Giotto radio science experiment representing the Doppler frequency shift and the intensity level of the X-band downlink signal of the Giotto spacecraft during its encounter with comet Halley are shown. Continuous data reception was maintained throughout the encounter. The Doppler shift measured within a time interval of 100 sec is due to drag effects in the cometary atmosphere causing a deceleration of the spacecraft. The total change of velocity of Giotto is 23.2 cm/sec resulting in a best estimate of 0.32 g for the total cometary mass impacting Giotto during the Halley flyby. A dust jet structure for the inner coma of comet Halley is derived. Several sharply confined dust jets are distinguishable; for the most prominent one, characteristic properties are deduced. Features of this jet structure are shown to correlate with measurements from on-board Giotto experiments and with Earth-based observations.

2027 (ESA-SP—250-VOL-2, pp 8) **Cometary nucleus: current concepts.** Whipple, F.L. Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Ideas concerning the nature of cometary nuclei as modified by observations of recent years, particularly by those of Halley's comet during the 1986 apparition are reviewed. The major trend is to increase the postulated dimensions of the nuclei and reduce their albedos. The Vega and Giotto missions establish an invaluable checkpoint with regard to comet nuclei. These and other observations are affecting opinions concerning many facets of cometary nature, origin, evolution, and decay.

2028 (ESA-SP—250-VOL-2, pp 4) **Nucleus morphology of Comet Halley.** Reitsema, H.J.; Delamere, W.A.; Huebner, W.F.; Keller, H.U.; Schmidt, W.K.H.; Wilhelm, K.; Schmidt, H.U.; Whipple, F.L. (Smithsonian Astrophysical Observatory, Cambridge, MA). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Images obtained by the Halley multicolor camera were used to determine the projected size and shape of the nucleus. The location of the terminator and numerous surface features were determined. There is good correlation between the brightest surface features and the dust jets; however, many bright features are seen which are not associated with jets. Most of the observed features are circular and appear to be related to surface elevation. The angularity of the terminator gives an indication of the three-dimensional structure of the face which was observed.

2029 (ESA-SP—250-VOL-2, pp 3) **Radiometric observations of the nucleus of Comet Halley.** Delamere, W.A.; Reitsema, H.J.; Huebner, W.F.; Schmidt, H.U.; Keller, H.U.; Schmidt, W.K.H.; Wilhelm, K.; Whipple, F.L. (Smithsonian Astrophysical Observatory, Cambridge, MA). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

Images obtained by the Halley multicolor camera (HMC) were used to determine the surface brightness of the nucleus. Radiometric values of jet-free areas of the surface are presented and a range of possible surface brightness values are derived. These direct measures are compared with brightnesses derived from the size of the nucleus, as determined from HMC images, and ground-based observations obtained before the onset of coma activity.

2030 (ESA-SP—250-VOL-2, pp 2) **Dust-gas interaction deduced from Halley multicolor camera observations.** Huebner, W.F.; Keller, H.U.; Wilhelm, K.; Whipple, F.L.; Delamere, W.A.; Reitsema, H.J.; Schmidt, H.U. (Max-Planck-Institute fuer Physik und Astrophysik, Garching, West Germany). Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

The dust and gas productions of comet Halley were measured by the dust counter and the mass spectrometers on the Giotto spacecraft. These instruments give only little information about the spatial asymmetry of the activity. The asymmetry in the dust production is clearly evident from the dust jets seen in the Halley Multicolor Camera images. Since the dust is entrained by the gas, gas production must be similarly asymmetric. The intensity profiles along and across several dust jets are related to their source regions on the nucleus. Properties of the dust jets are investigated. A few compact, but highly active source regions on the nucleus produce most of the visible dust and can account for most of the gas produced by the comet.

2031 (ESA-SP—250-VOL-2, pp 7) **Physical interpretations from the motions of comets Halley and Giacobini-Zinner.** Yeomans, D.K. Dec 1986. NTIS, PC A20/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99859).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 2: Dust and Nucleus.

For comets Halley and Giacobini-Zinner (GZ), the model of the rocket-like, outgassing forces affecting the comet motion is shown to be consistent with the vaporization of water ice from the comet nuclei. For comet GZ, the dramatic time dependence of the outgassing forces suggests that this comet's spin axis passed through the orbit plane in the mid 1960's. Modeling of Halley's motion over two millennia indicates that the comet is rotating in a direct sense, with no obvious long-term time dependence in the average outgassing forces. The precession of the spin pole axis is not apparent. Secular changes in the comet's angular elements show no evidence for a ring of comet-like material beyond the orbit of Neptune. An obvious 1986 postperihelion bias in comet Halley's observation residuals is modeled by assuming a radial center-of-light/center-of-mass offset.

2032 (ESA-SP—250-VOL-3, pp 5) **Ionospheric extent of P/Halley from ground based operations during the 1985-1986 apparition.** Mccarthy, P.J.; Strauss, M.A.; Spinrad, H. Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Spatial profiles of $H_3O(+)$ emission in the inner coma of P/Halley on 8 dates during the 1985 to 1986 apparition are presented. The profiles are derived from two dimensional CCD spectrograms taken with the spectrograph slit oriented along the cometary radius vector. The observations cover the range from 16 Oct. 1985 (r = 2.14 AU preperihelion) to 6 June 1986 (r = 2.14 AU postperihelion). The surface brightness profile of the 6198A $H_3O(+)$ emission line is calibrated in terms of the column density of $H_3O(+)$ ions. The profile from 14.4 Mar. 1986 is compared with the Giotto Ion Composition Experiment measurement of the shape of the $H_3O(+)$ space density profile. The ionosphere becomes larger and steeper in the sunward direction with an increasing water production rate.

2033 (ESA-SP—250-VOL-3, pp 3) **Ground-based detection of water in Comet Halley.** Knacke, R.F.; Noll, K.S.; Brooke, T.Y.; Geballe, T.R.; Tokunaga, A.T. (Hawaii Univ., Honolulu). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Gaseous water was detected in the coma of comet Halley. Emission was observed in the upsilon 1 + upsilon 3 band at 1.4 microns, and the upsilon 2 + upsilon 3 band at 1.9 microns. Based on the upsilon 1 + upsilon 3 band intensity, the mass loss rate is 2 times 10 to the 29th power molecules/sec (with an uncertainty of a factor of 2) on 29 Oct. 1985, marginally consistent with other detections. The method is applicable to observations of H_2O in other fast-moving comets.

2034 (ESA-SP—250-VOL-3, pp vp) **Comet Halley: the Curtis Schmidts-Isla de Pascua observations.** Miller, F.D.; Liller, W. (Ministerio de Educacion, Santiago, Chile). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Halley's comet plasma tail disturbances and attendant tail phenomena were observed. Nearly simultaneous exposures with two telescopes serve to correlate information obtained with the two instruments. Photographs of 14 pre-Halley comets taken on 54 nights were examined with a view to cross-interpretation of phenomena seen in Halley with the earlier comets, as recorded on a homogenous collection of plates taken with the same instrument. The tail of Halley was highly active. This contrasts sharply with pre-Halley comets where undisturbed tails are the rule. During March and April, disturbances appeared in the tail of Halley at an average of 1 new distrubance every 3.7 days. It is considered that 10 of the 11 observed disturbances had common characteristics which allow them to be characterized as disconnections.

2035 (ESA-SP—250-VOL-3, pp vp) **Dynamic pressure model derived from an observation by Sakigake for Comet Halley on 31 December, 1985.** Saito, T.; Yumoto, K.; Hirao, K.; Saito, K.; Nakagawa, T.; Smith, E. (Onagawa Magnetic Observatory, Japan). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

An outstanding disconnection event (DE)-like knot was observed on 31 Dec. 1985 in P/Halley's tail. Analysis of the Sakigake/IMF data reveals that comet Halley did not encounter the heliospheric neutral sheet on the day, demanding a new explanation of the DE-like event. During this event, the comet encountered a high-speed solar wind from a coronal hole tongue of the Sun. The event can be explained by a dynamic pressure model, according to which the DE-like plasmoid was caused by a sudden increase in the dynamic pressure of the solar wind. A simulation result is found to support this interpretation. The dynamic pressure model for a comet can be compared with the mechanism of a possible geotail disturbance during a spacecraft triggered auroral substorm.

2036 (ESA-SP—250-VOL-3, pp vp) **Strong hydromagnetic fluctuations in the Comet P/Halley magnetosphere observed by the Giotto magnetic field experiment.** Glassmeier, K.H.; Neubauer, F.M.; Acuna, M.H.; Marian, F. (Rome Univ., Italy). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Strong hydromagnetic fluctuations were observed in the induced magnetosphere of comet Halley. Several regions were identified showing either strong turbulence, characterized by the absence of strong fluctuations, or showing isolated, quasi-coherent wave trains above a turbulent background. Visual inspection of the wave trains shows no preferred sense of polarization, i.e., they may be of transverse, compressional, or mixed polarization. Spectral analysis shows peak power at various frequencies, corresponding, for example, to water group or hydrogen ion cyclotron resonances. Analysis of a peculiar type of oscillation with 25 sec period suggests strong contributions from off-angle propagating waves.

2037 (ESA-SP—250-VOL-3, pp vp) **Macroscopic perturbations of the Interplanetary Magnetic Field (IMF) by P/Halley as seen by the Giotto magnetometer.** Raeder, J.; Neubauer, F.M.; Ness, N.; Burlaga, L.F. (Cologne Univ., West Germany). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Giotto magnetic field data were used to analyze the macroscopic field structure in the vicinity of P/Halley. During the Giotto flyby at comet P/Halley the IMF showed a quite stable away polarity. Draping of magnetic field lines is clearly observed along the outbound leg of the trajectory. Inside the magnetic pile-up region the field reverses its polarity several times. A symmetry of oppositely magnetized sheets with respect to the nucleus is found and explained in terms of convected IMF features.

2038 (ESA-SP—250-VOL-3, pp vp) **NASA C-141/KAO Comet Halley observations.** Haughney, L.C.; Mumma, M.J. (Goddard Space Flight Center, Greenbelt, MD). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

Original contains color illustrations.

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

As part of NASA's Airborne Astronomy Program, research teams studied the infrared emissions of comet Halley before and after perihelion from NASA's C-141 Kuiper Airborne Observatory (KAO) and from NASA's Lear Jet Observatory (LJO). The objectives were to determine the presence of water vapor and other molecules and the composition of dust in the coma and nucleus. The C-141/KAO, the LJO, the detecting instruments, and the observational flight plans are described. The observed spectral range extended from 2 to 800 microns, plus wide-field, visible photography. The C-141/KAO's flights occurred in December 1985 from California and in March and April 1986 from New Zealand. The LJO's observations were made from Kwajalein Island in April 1986.

2039 (ESA-SP—250-VOL-3, pp vp) **Spectroscopy of comets; an infrared perspective.** Larson, H.P.; Mumma, M.J.; Weaver, H.A.; Davis, D.S. (Arizona Univ., Tucson). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Incontrovertible evidence for neutral H_2O as an abundant volatile species in any comet contained in near-infrared airborne spectra of Comet Halley is discussed. The airborne spectra are compared with previous infrared studies of comets and with other investigations of comet Halley. The airborne measurements establish criteria for evaluating the spectroscopic sensitivities of future studies of comets with remote infrared methods.

2040 (ESA-SP—250-VOL-3, pp vp) **Comet coma sample return.** Tsou, P.; Brownlee, D.E.; Albee, A.L. (California Institute of Technology, Pasadena). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

The feasibility of capturing comet dust with polymer foam, dense gas, and fiber collectors is discussed. Polystyrene foams seem suitable. For volatile capture, chemically active getters are suggested. A scenario for a low speed flyby sample return mission is outlined.

2041 (ESA-SP—250-VOL-3, pp vp) **ICQ photometric archive for P/Halley and other comets.** Green, D.W.; Rokoske, T.L.; Morris, C.S. (Appalachian State Univ., Boone, NC). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

The International Comet Quarterly (ICQ) archive is introduced. There is still no electronic (e.g., photoelectric photometers, CCDs) means for readily obtaining total visual magnitudes of comets when the coma diameters are greater than 20 arcsec and visual estimates of the total brightness are still the most abundant type of data for comets during the past 100 yr besides astrometric data. The ICQ published greater than 18,000 visual observations of comets made by 600 observers since 1940. What is available, what is accomplished thus far, and potentials and limitations inherent in the ICQ photometric data archive are discussed.

2042 (ESA-SP—250-VOL-3, pp vp) **Systematics of the CHON and other light-element particle populations in Comet Halley.** Clark, B.; Mason, L.W.; Kissel, J. (Max-Planck-Institute fuer Kernphysik, Heidelberg, West Germany). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Based on chemical signatures measured by the PIA experiment during the Giotto flyby of comet Halley, particle classifications were designated. In addition to silicate-like grains and particles of mixed (cosmic) composition, there appear to be several light-element rich populations, including the CHON, (H,C), (H,C,O), and (H,C,N) particle types. These compositional classes are further distinguished by differences in mass distributions, a density indicator, and variations in relative abundance within the coma. These particle populations are evidence for chemical heterogeneity in the surface of the cometary nucleus. Particles found mainly in the inner coma may be volatile icy grains. Most of the N of the comet may be bound in up to three different populations of grains; one or more of these may be responsible for the observation of cyanojets.

2043 (ESA-SP—250-VOL-3, pp vp) **Measurements of thermal ion energy spectra from the Giotto encounter with Comet Halley.** Hodges, R.R.; Illiano, J.M.; Berthelier, J.J.; Krankowsky, D.; Laemmerzahl, P.; Woweries, J.; Stubbemann, U.; Hoffmann, J.H.; Eberhardt, P.; Dolder, U. (Bern Univ., Switzerland). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Ram ion measurements made by the Giotto neutral mass spectrometer show the spatial evolution of the composition and energy spectrum of coma ions. Near the nucleus the plasma is cold and has many constituents, but at distances of the order of 200,000 km the main ions are the terminal products of water dissociation, H(+) and O(+). The ion velocity distribution at the time of the Giotto encounter is highly anisotropic. Ion flow is generally away from the comet with energies increasing with distance to the order of 100 eV in the comet frame of reference. Similarities in the proton and oxygen ion energy spectra in the comet frame suggest an acceleration mechanism other than v x B pickup.

2044 (ESA-SP—250-VOL-3, pp vp) **Plasma-tail activity at the time of the Vega encounters.** Niedner, M.B. Jr.; Schwingensuch, K. (Academy of Sciences, Graz, Austria). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Physical associations are sought between Halley's plasma tail activity seen in ground-based imagery and near-comet, solar wind/IMF measurements obtained by the Vega spacecraft. Disconnection Events (DE's) and the sector boundary/frontside magnetic reconnection model (Niedner and Brandt, 1978) of their origin are discussed. Strong support for the model comes from 2 DE's: a major event whose onset, on March 7 to 8, is strongly correlated with a reversal of the comet's magnetic barrier observed by Vega-1 and Vega-2 and with an IMF sector boundary observed by Vega-1; and a minor event on March 7 which may be associated with the two-polarity (possibly reconnecting) magnetic barrier seen by Vega-1 on March 6, when the solar-wind density was low.

2045 (ESA-SP—250-VOL-3, pp vp) **Carbon clusters as a source of C, C_2, C_3 and their ions in the atmospheres of Comets Giacobini-Zinner and Halley.** Ogilive, K.W.; Coplan, M.A.; Ahearn, M.F. (Maryland Univ., College Park). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

The encounters of spacecraft with comets Giacobini-Zinner and Halley show anomalously high relative abundances of $C_3(+)$ and C(+) respectively. It is suggested that carbon clusters may be important in the production of these anomalies.

2046 (ESA-SP—250-VOL-3, pp vp) **Upstream waves of cometary origin detected by the Giotto magnetic field experiment.** Acuna, M.H.; Glassmeier, K.H.; Burlaga, L.F.; Neubauer, F.M.; Ness, N.F. (Cologne Univ., West Germany). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Upstream waves associated with water group ions were detected by Giotto up to 5.2 million km from the nucleus of comet Halley. They show predominantly quasi-linear polarization with spectral characteristics typical of turbulent cascade processes. Spectral power densities are well above solar wind levels and at similar or lower levels than those observed near comet Giacobini-Zinner. The waveforms exhibit different characteristics from those detected by the ICE mission. Wavefront steepening and associated higher frequency wave packets are not identified.

2047 (ESA-SP—250-VOL-3, pp vp) **MHD waves detected by ICE at distances greater than or = 28 million km from Comet Halley: Cometary or solar wind origin?.** Tsurutani, B.T.; Brinca, A.L.; Smith, E.J.; Thorne, R.M.; Scarf, F.L.; Gosling, J.T.; Ipavich, F.M. (Maryland Univ., College Park). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Spectral analyses of the high resolution magnetic field data are employed to determine if there is evidence of cometary heavy ion pickup when ICE was closest to Halley. No evidence for the presence of heavy ion cyclotron waves is found. However, two wave modes are discovered in the solar wind: electromagnetic ion cyclotron waves and drift mirror mode waves. Both modes have scales of 10 to 60 s (1 to 6 Tp) in the spacecraft frame. The possibility of wave generation by cometary hydrogen pickup is explored. Theoretical and experimental evidence indicates that cometary origin is improbable. The most likely source is plasma instabilities associated with solar wind stream-stream interactions. Very low frequency electrostatic emissions occur in field minima or at gradients of the drift mirror structures. Possible generation mechanisms of drift mirror mode waves, cyclotron waves, and electrostatic waves are discussed.

2048 (ESA-SP—250-VOL-3, pp vp) **Steepened magnetosonic waves in the high beta plasma surrounding Comet Giacobini-Zinner.** Tsurutani, B.T.; Smith, E.J.; Thorne, R.M.; Gosling, J.T.; Matsumoto, H. (Kyoto Univ., Japan). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Studies of intense hydromagnetic waves at Giacobini-Zinner are extended to investigate the mode and direction of wave propagation. Simultaneous high-resolution measurements of electron density fluctuations demonstrate that long period waves propagate in the magnetosonic mode. Principal axis analyses of the long period waves and accompanying partial rotations show that the sum of the wave phase rotations is 360 deg, indicating that both are parts of the same wave oscillation. The time sequence of the steepened waveforms observed by ICE shows that the waves must propagate towards the Sun with Cph less than Vsw. Observations are consistent with wave generation by resonant ion ring or ion beam instability which predicts right-hand polarized waves propagating in the ion beam (solar) direction. The large amplitudes and small scale sizes of the cometary waves suggest that rapid pitch-angle scattering and energy transfer with energetic ions should occur. Since the waves are highly compressive, first-order Fermi acceleration is forecast.

2049 (ESA-SP—250-VOL-3, pp vp) **Analysis of the Giacobini-Zinner bow wave.** Smith, E.J.; Slavin, J.A.; Bame, S.J.; Thomsen, M.F.; Cowley, S.W.H.; Richardson, I.G.; Hovestadt, D.; Ipavich, F.M.; Ogilive, K.W.; Coplan, M.A. (Maryland Univ., College Park). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

The cometary bow wave of P/Giacobini-Zinner was analyzed using the ICE field and particle observations to determine if it is a shock. Changes in the magnetic field and plasma flow velocities from upstream to downstream were analyzed to determine the direction of the normal and the propagation velocity of the bow wave. The velocity was compared with the fast magnetosonic wave speed upstream to derive the Mach number and establish whether it is supersonic, i.e., a shock, or subsonic, i.e., a large amplitude wave. The measurements were compared with values derived from a Rankine-Hugoniot analysis. The results indicate that inbound the bow wave is a shock with M = 1.5. Outbound, a subsonic Mach number is obtained. However, arguments that the bow wave is also likely to be a shock at this location are presented.

2050 (ESA-SP—250-VOL-3, pp vp) **Pre-perihelion observations of Comet Halley at 2-13 microns.** Lynch, D.K.; Russell, R.W.; Retig, D.A.; Rice, C.J.; Young, R.M. Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Between Nov. 8, 1985 and Jan. 13, 1986 comet Halley brightness was obtained as a function of time at 2.3, 3.6, 4.6, and 10.3 microns. Brightness outbursts were noted, an especially significant one beginning Jan. 10, 1986 and persisting for several days during which the IR brightness more than doubled. The heliocentric brightness indices for 2.3, 3.6, 4.6, and 10.3 microns are -5.7, -7.1, -8.5, and -6.2, respectively. Comet Halley's absolute magnitudes at these wavelengths are 7.3, 4.4, 2.8, and -1.8. The 4.6 to 10.3 micron color temperature dependence on heliocentric distance (R) is slightly less steep than the Rsup -1/2 expected theoretically. The albedo of the comet is 8% to 9%. Based on spectral differences between outbursts on Nov. 8, 1985 and Jan. 10 to 13, 1986, it is concluded that the comet displays composition inhomogeneities.

2051 (ESA-SP—250-VOL-3, pp vp) **Spectral development of Comet P/Halley from August 1985 to June 1986.** Fink, U.; Disanti, M.; Schultz, A. Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Spectra of comet Halley were obtained every month from 1985 Aug. to 1986 June, from 5200 to 10,400 A at a spectral resolution of 12 A. Spatial extent is 200" along the slit. A variety of spatially resolved spectra with the slit along the tail and perpendicular to the tail were recorded. Emission species observed are C_2, CN, NH_2, $H_3O(+)$, (OI) and NaI. The 2-0 C_2 Phillips band is detected at 8750 A, and from its intensity ratio of 1/9 to the 0-1 Swan band a preliminary C_2 singlet to triplet intercombination probability of less than 10 to the minus 7th power is derived. Sodium emission is observed stongly only in 1986 Mar. data.

2052 (ESA-SP—250-VOL-3, pp vp) **Photoelectric photometry of Comet P/Halley from Mauna Kea Observatory.** Piscitelli, J.R.; Tholen, D.J.; Hammel, H.B.; Lark, N. (Univ. of the Pacific, Stockton, CA). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

A program of photoelectric photometry of comet Halley yielded 60 nights of usable photometry. The uncertainty in the photometry in all filters except OH is better than 2%. Throughout the apparition, the comet is brightest in the filters that isolated the neutral gas emission features of OH, CN, C_3, and C_2. The fluxes in the filters that isolated the ionic emission features of CO(+) and $H_3O(+)$ are comparable to the continuum when centered upon the optocenter, thereby making the ionic emission weak to undetectable above the continuum. The continuum colors do not appear to be a function of phase angle; therefore, the colors are probably indicative of dust grain composition and are not dominated by scattering geometry effects.

2053 (ESA-SP—250-VOL-3, pp vp) **Comparison of the continuum colors of P/Halley, other comets, and asteroids.** Tholen, D.J.; Cruickshank, D.P.; Hammel, H.B.; Piscitelli, J.R.; Hartmann, W.K.; Lark, N. (Univ. of the Pacific, Stockton, CA). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Early observations (1985 Feb.) of P/Halley were made with broadband BVJK filters when a substantial fraction of the light came from the nucleus; the resulting colors appear red, but with signal-to-noise ratios less than or = 5. More recent observations were made with the narrower International Halley Watch continuum filters when the light from the comet is dominated by the coma. The colors over the wavelength range 0.3 to 0.7 microns are more neutral. Continuum colors were also observed for other comets. All show moderately red to very red colors that can be best matched by asteroids of the P and D spectral classes, suggesting that the refractory component of comets is similar to that of the more distant asteroids.

2054 (ESA-SP—250-VOL-3, pp vp) **Post-perihelion brightening of Halley's Comet: a case of nuclear summer.** Weissman, P.R. Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Increased brightness and gas production rates for Halley's comet after perihelion are explained as a result of seasonal effects on an obliquely rotating nucleus. The highly eccentric cometary orbit causes a rapid change in solar declination as the comet rounds perihelion, resulting in drastic changes in the insolation reaching the Northern and Southern Hemispheres of the nucleus. The rapid heating of the Northern Hemisphere post-perihelion likely results in substantial cracking of the non-volatile surface crust due to thermal stresses, exposing areas of fresh volatile ices. The orientation of the triaxial ellipsoid nucleus may also play a role in exposing more surface area to continuous sunlight and sublimation after perihelion. Post-perihelion brightening models based on heat flow and storage in sub-surface layers of the nucleus pre-perihelion are likely not viable because of the low thermal conductivities of porous, low density cometary surface materials.

2055 (ESA-SP—250-VOL-3, pp vp) **Fractal model of a cometary nucleus formed by random accretion.** Donn, B.; Hughes, D. (Sheffield Univ., England). Dec 1986. NTIS, PC A23/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99860).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's comet. Volume 3: Posters.

Numerical simulations of the structure of aggregates of grains in the solar system show they are fractals with low density and irregular shapes. Comet nuclei forming from a mixture of ice and dust grains are likely to have nonuniform composition as well as structure. Such a nucleus appears to account for observed characteristic of comets. The structure has significant implications for the evolution of cometary nuclei.

2056 (INIS-BR—721) **Electron capture and stellar collapse.** Chung, K.C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1979. 173p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87703473/JAW.

In order, to investigate the function of electron capture in the phenomenon of pre-supernovae gravitational collapse, an hy-

drodynamic caculation was carried out, coupling capture, decay and nuclear reaction equation system. A star simplified model (homogeneous model) was adopted using fermi ideal gas approximation for tthe sea of free electrons and neutrons. The non simplified treatment from quasi-static evolution to collapse is presented. The capture and beta decay rates, as wellas neutron delayed emission, were calculated by beta decay crude theory, while the other reaction rates were determined by usual theories. The preliminary results are presented. (M.C.K.).

2057 **(INIS-BR—818) Observation and analysis of cosmic electromagnetic cascades detected in lead photoemulsion chamber of the Brazil-Japan cooperation, exposed in Monte Chacaltaya, Bolivia (altitude 5200m, air pressure 550 gr.cm/sup -2/).** Bastos, C.A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Apr 1971. 128p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703716/JAW.

The cosmic gamma radiations in the photoemulsion chamber for Brazil-Japan Cooperation are studied. These radiations reproduces the electromagnetic component of extensive air showers at the begining of its development through the atmosphere. The gamma radiations, which is /sup 0/PI meson decay products emitted in nuclear interaction, are detected by electromagnetic cascades which are developed when they reach the photoemulsion chamber. Cosmic gamma radiations is a set of parallel electromagnetic cascades proceeding from nuclear interactions. The information about high energy nuclear interactions making possible to study the structure of extensive air showers at the beginning of its development and multiple meson production are obtained. (M.C.K.).

2058 **(INIS-mf—10982) Stars, gas, and dust in the Andromeda Galaxy.** Walterbos, R.A.M. (Rijksuniversiteit Leiden (Netherlands)). 3 Sep 1986. 209p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE87703570/JAW.

In this thesis the results of an extensive observational study are presented of the properties of the stellar disk and bulge, the dust, and the gas in the Andromeda nebula (M31). A detailed analysis of the RAS results on M31 is given. In addition, new complete multi-color data on the optical light distribution are described. Together with a high-resolution radio continuum survey at 21 cm. The general morphological aspects of the different compounds are discussed. The analysis further focusses on the correlations between various components, in particular on that between gas and dust. (Auth.). Includes Dutch summary

2059 **(INPE—3667) Synchrotron/inverse Compton interpretation of a solar burst producing fast pulses at $\lambda < 3$ mm and hard X-rays.** Kaufmann, P.; Correia, E.; Costa, J.E.R.; Vaz, A.M.Z. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Nov 1985. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703764/JAW.

The recently discovered new class of solar burst emission component exhibiting very fast pulses (durations — 60 ms) at mm-waves only (λ < 3mm) and at hard X-rays, poses serious constraints for interpretations. Ultrarelativistic electrons are likely to be required in order to explain the high spectral turnover frequency. The time scales, however, are too small to be explained by synchrotron losses alone, or by bremsstrahlung losses, unless extremely large ambient plasma densities are assumed. It is interpreted that the mm-wave emission is associated with a synchrotron component and hard X-rays are associated with the inverse Compton process. The observed mm-wave emission is in the optically thick part of a spectrum peaking somewhere in the infrared range of frequencies, and the electron energies are reduced primarily by inverse Compton quenching on the synchrotron source photons. The model explains self-consistently the X-rays/sub-mm flux ratio and the short time scales. It also accounts for typical fluxes reported for white light flares. The synchrotron emission component should peak at about 10/sup 13/ Hz, the burst sources must be short lived (— 60 ms), very small (< or approx. 10/sup 7/cm) and exhibiting high apparent brightness temperature (> or approx. 10/sup 10/ K). This study suggest further theoretical studies on the nature of the primary acceleration sources, and on their location in the solar atmosphere. A number of crucial observational tests are needed, specially in the sub-mm and infrared range of frequencies, as well as at ratio and hard X-rays with simultaneous high spatial and time resolution.

2060 **(LBL—23037) Influences of the astrophysical environment on nuclear decay rates.** Norman, E.B. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 11p. (CONF-870802—23). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001461/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

In many astronomical environments, physical conditions are so extreme that nuclear decay rates can be significantly altered from their laboratory values. Such effects are relevant to a number of current problems in nuclear astrophysics. Experiments related to these problems are now being pursued, and will be described in this talk. 19 refs., 5 figs.

2061 **(LBL—23795) Center for X-Ray Optics, 1986.** (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000715/JAW.

The Center for X-Ray Optics has made substantial progress during the past year on the development of very high resolution x-ray technologies, the generation of coherent radiation at x-ray wavelengths, and, based on these new developments, had embarked on several scientific investigations that would not otherwise have been possible. The investigations covered in this report are topics on x-ray sources, x-ray imaging and applications, soft x-ray spectroscopy, synchrotron radiation, advanced light source and magnet structures for undulators and wigglers. (LSP)

2062 (N—87-25884, pp 6) **Solar prediction and intelligent machines.** Johnson, G.G. Jun 1987. NTIS, PC A13/MF A01. (NASA-CR—171984-VOL-2; NAS—1.26:171984-VOL-2).

In National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, Volume 2.

The solar prediction program is aimed at reducing or eliminating the need to throughly understand the process previously developed and to still be able to produce a prediction. Substantial progress was made in identifying the procedures to be coded as well as testing some of the presently coded work. Another project involves work on developing ideas and software that should result in a machine capable of learning as well as carrying on an intelligent conversation over a wide range of topics. The underlying idea is to use primitive ideas and construct higher order ideas from these, which can then be easily related one to another.

2063 **(N—87-25903) Observations made with the International Ultraviolet Explorer. Final technical report.** Margon, B. (Washington Univ., Seattle (USA)). Jul 1987. 7p. (NASA-CR—181117; NAS—1.26:181117). NTIS, PC A02/MF A01.

Observations were made with the International Ultraviolet Explorer of two quite diverse astronomical objects. The first is an extremely ultraviolet excess star projected near the globular cluster M5. The second is a previously unrecognized but very bright starburst galaxy. Each of these objects is discussed in detail.

2064 **(N—87-25904) Ultraviolet spectra of two magnetic white dwarfs and ultraviolet spectra of subluminous objects found in the Kiso Schmidt survey. Semiannual report, 1 January-30 June 1987.** Wegner, G.A. (Dartmouth Coll., Hanover, NH (USA)). Jul 1987. 14p. (NASA-CR—181122; NAS—1.26:181122). NTIS, PC A02/MF A01.

Low resolution International Ultraviolet Explorer (IUE) spectroscopic observations of two magnetic white dwarfs BPM25114 and K813-14 were obtained using both the SWP and LWP cameras. The first object has an observed magnetic field of 4 x 10(7) Gauss and the second has one of 3 x 10(7) Gauss. Both objects have overall spectral energy distributions appropriate for cool DA white dwarfs with T(eff) near 10,000 K and accordingly show strong lambda lambda 1400 and 1600 absorption in their spectra.

Compared to non-magnetic DA white dwarfs of comparable effective temperature, there are some differences in the profiles, presumably produced by the magnetic fields in these objects. In addition, the ultraviolet spectra of a number of hot subluminous stars in the Kiso Schmidt survey were observed.

2065 **(N—87-25905) Theoretical interpretation of the HEAO-3 observations of Cygnus X-3 under the HEAO-3 Guest Investigator Program. Final technical report, 1 July 1985-30 June 1987.** Marscher, A.P. (Boston Univ., MA (USA)). Jul 1987. 9p. (NASA-CR—181171; NAS—1.26:181171). NTIS, PC A02/MF A01.

A model of the galactic x-ray source Cygnus X-3 (Cyg X-3) is presented which deviates from previous models by positing that the x rays originate in a jet rather than a binary system consiting of an ordinary star and a collapsed object. In the new model, the 4.8 hour period of Cyg X-3 is caused by variable absorption which occurs as the jet precesses. The primary role of the accretion disk corona (ADC) in modulating Cyg X-3 radiation is to make the observed intensity of a blob of material in a jet appear dimmer by absorption. The needed derivation of the positional dependence of the density of the ADC is freed of some complications by assuming that only the inner regions of the disk are precessing, with a period shorter than 4.8 hours. This model permits the secondary star to be a supergiant, as indicated by the luminosity of the system. The model is especially helpful in interpreting production of radio outbursts and very high energy gamma rays.

2066 **(N—87-25982) Rapid temporal evolution of radiation from non-thermal electrons in solar flares.** Lu, E.T.; Petrosian, V. (Stanford Univ., CA (USA)). Jun 1987. 31p. (NASA-CR—181055; NAS—1.26:181055; CSSA-ASTRO—87-5). NTIS, PC A03/MF A01.

Solutions of the time dependent Fokker-Planck equation was found for accelerated electrons undergoing Coulomb collisions in a magnetized, fully ionized plasma. An exact solution was found for arbitrary pitch angle and energy distribution in a uniform background plasma. Then, for an inhomogeneous plasma, a solution was found for particles with small pitch angles. These solutions were used to calculate the temporal evolution of bremsstrahlung x-rays from short bursts of nonthermal electron beams, and these spectra were compared with observed high time resolution spectra of short timescale solar hard x-ray bursts. It is shown that the observed softening in time of the spectra rules out a homogeneous background and therefore the possibility of electrons being confined to the corona either because of converging magnetic field or high densities. The inhomogeneous solution was also applied to a model with constant coronal density and exponentially rising chromospheric density. The spectra are shown to be consistent with that produced by a collimated beam of electrons accelerated in the corona with certain given conditions. These conditions could be violated if large pitch angle electrons are present.

2067 (N—87-26531, pp vp) **Phase space simulation of collisionless stellar systems on the massively parallel processor.** White, R.L. Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

A numerical technique for solving the collisionless Boltzmann equation describing the time evolution of a self gravitating fluid in phase space was implemented on the Massively Parallel Processor (MPP). The code performs calculations for a two dimensional phase space grid (with one space and one velocity dimension). Some results from calculations are presented. The execution speed of the code is comparable to the speed of a single processor of a Cray-XMP. Advantages and disadvantages of the MPP architecture for this type of problem are discussed. The nearest neighbor connectivity of the MPP array does not pose a significant obstacle. Future MPP-like machines should have much more local memory and easier access to staging memory and disks in order to be effective for this type of problem.

2068 (N—87-26531, pp vp) **Block iterative restoration of astronomical images with the massively parallel processor.** Heap, S.R.; Lindler, D.J. (Advanced Computer Concepts, Potomac, MD). Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

A method is described for algebraic image restoration capable of treating astronomical images. For a typical 500 x 500 image, direct algebraic restoration would require the solution of a 250,000 x 250,000 linear system. The block iterative approach is used to reduce the problem to solving 4900 121 x 121 linear systems. The algorithm was implemented on the Goddard Massively Parallel Processor, which can solve a 121 x 121 system in approximately 0.06 seconds. Examples are shown of the results for various astronomical images.

2069 (N—87-26531, pp vp) **Reconstruction of coded aperture images.** Bielefeld, M.J.; Yin, L.I. (Space Telescope Science Institute, Baltimore, MD). Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

Balanced correlation method and the Maximum Entropy Method (MEM) were implemented to reconstruct a laboratory x-ray source as imaged by a Uniformly Redundant Array (URA) system. Although the MEM method has advantages over the balanced correlation method, it is computationally time consuming because of the iterative nature of its solution. Massively Parallel Processing, with its parallel array structure is ideally suited for such computations. These preliminary results indicate that it is possible to use the MEM method in future coded-aperture experiments with the help of the MPP.

2070 (N—87-26531, pp vp) **Real time animation of space plasma phenomena.** Jordan, K.F.; Greenstadt, E.W. Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

In pursuit of real time animation of computer simulated space plasma phenomena, the code was rewritten for the Massively Parallel Processor (MPP). The program creates a dynamic representation of the global bowshock which is based on actual spacecraft data and designed for three dimensional graphic output. This output consists of time slice sequences which make up the frames of the animation. With the MPP, 16384, 512 or 4 frames can be calculated simultaneously depending upon which characteristic is being computed. The run time was greatly reduced which promotes the rapid sequence of images and makes real time animation a foreseeable goal. The addition of more complex phenomenology in the constructed computer images is now possible and work proceeds to generate these images.

2071 (N—87-26692, pp 25) **Spectral characterization of Martian soil analogues.** Agresti, D.G. Jun 1987. NTIS, PC A16/MF A01. (NASA-CR—171984-VOL-1; NAS—1.26:171984-VOL-1).

In National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, Volume 1.

As previously reported, reflectance spectra of iron oxide precipitated as ultrafine particles, unlike ordinary fine grained hematite, have significant similarities to reflectance spectra from the bright regions of Mars. These particles were characterized according to composition, magnetic properties, and particle size distribution. Mossbauer, magnetic susceptibility, and optical data were obtained for samples with a range of concentrations of iron oxide in silica gel of varying pore diameters. To analyze the Mossbauer spectra, a versatile fitting program was enhanced to provide user friendly screen input and theoretical models appropriate for the superparamagnetic spectra obtained.

2072 (N—87-26692, pp 14) **Interpreting the production of 26Al in Antarctic meteorites.** Heydegger, H.R. Jun 1987. NTIS, PC A16/MF A01. (NASA-CR—171984-VOL-1; NAS—1.26:171984-VOL-1).

In National Aeronautics and Space Administration (NASA)/ American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, Volume 1.

Large numbers of meteorites have been concentrated at several locations in Antarctica. Glaciological mechanisms of grossly different time scales have been proposed to account for their transport by the ice, and the frequency distribution of the terrestrial ages of these objects has been suggested as a means of determining the relevant time scales. The upper limit to the ages of ice in Antarctica which would emerge from such a project is of interest to many other disciplines. After a meteorite reaches the Earth's surface, the specific radioactivity of Al-26 produced by cosmic rays while it was in space decreases because shielding by the Earth's atmosphere reduces further production to a neglible level. Thus, the known half life of this species can be used to determine the object's terrestrial age if the specific radioactivity at time of fall can be determined with reasonable accuracy and precision. The several models utilized for these predictions were based on the limited data available nearly two decades ago. The much larger data base now available was examined using multiple parameter regression analyses.

2073 (N—87-26713) **Meteoritic basalts: the nakhlites, their parental magmas, cooling rates, and equivalents on Earth. Final technical report.** Treiman, A.H. (Boston Univ., MA (USA)). Jul 1987. 10p. (NASA-CR—181133; NAS—1.26:181133). NTIS, PC A01/MF A01.

Proposed one-bar phase equilibrium experiments, designed to determine the compositions of the nakhlites' parental magmas, are in progress. Proposed field studies on Earth, designed to find occurrences of rocks like the nakhlites, were extraordinarily successful. Other work supported in the past year included: attendance at the 1986 national meeting of the Geological Society of America; attendance at the 18th Lunar and Planetary Science Conference; completion and publication of a study of core formation in the SNC parent body; initiation of a study of the flux of SNC meteorites onto the Earth; and initiation of petrologic study of the Angra dos Reis achondrite.

2074 (N—87-26820) **Magnetohydrodynamic model of the interaction of the solar wind with the Jovian magnetosphere and a magnetohydrodynamic simulation of the interaction of the solar wind with the out flowing plasma from a comet. Final report.** Walker, R.J. (California Univ., Los Angeles (USA)). 1987. 13p. (NASA-CR—181114; NAS—1.26:181114). NTIS, PC A02/MF A01.

A three-dimensional code for a rapidly rotating magnetosphere in which the MHD equations and the Maxwell equations were solved by using the two step Lax Endroff scheme, was developed. Preliminary results were presented at the Fall AGU meeting in San Francisco. The basic simulation model to study the solar wind interactions was adapted to other bodies in addition to Jupiter. Because of the recent comet flybys, a comet was chosen as the first model. The aim was to model the formation of the contact surface and the plasma tail. Later, work was begun on a three-dimensional model which would include the effects of mass loading. This model was designed to study the weak cometary bow shocks observed by the probes to comets Halley and Giacobini-Zinner. The model was successful in reproducing the position and shape of the bow shock which was determined by using observations from the Suisei spacecraft.

2075 (PB—87-217261/XAB) **Solar-Geophysical Data Number 514, June 1987. Part 1 (prompt reports). Data for May 1987, April 1987, and late data.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Jun 1987. 111p. (SGD—514-PT-1). NTIS, PC A06/MF A01.

See also Part 2, PB—87-217279, and PB—87-204939.

Contents include: Detailed index for 1986-1987; Data for May 1987; (IUWDS alert periods (Advance and Worldwide), Solar-activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field); Data for April 1987--(Solar-active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio-propagation indices); Late Data--(Solar-active regions, Pioneer 12 interplanetary magnetic field magnitudes October 1986; Cosmic-ray measurements by neutron monitor, Geomagnetic indices).

2076 (PB—87-217279/XAB) **Solar-Geophysical Data Number 514, June 1987. Part 2 (comprehensive reports). Data for December 1986.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Jun 1987. 33p. (SGD—514-PT-2). NTIS, PC A03/MF A01.

See also Part 1, PB—87-217261, and PB—87-204947.

Contents include: Detailed index for 1986-1987; Data for December 1986--Meudon carte synoptique; Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite graphs, Mass ejections from the sun, Active prominences and filaments, Miscellaneous data--Chinese solar-geophysical data (CSGD) (Explanation of Data Reports).

2077 (RAL—87-015) **Generation of Adlam-Allen waves by plasma release experiments in the solar wind.** Nairn, C.M.C.; Bingham, R.; Allen, J.E. (Rutherford Appleton Lab., Chilton (UK)). Mar 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752948/JAW.

Recent experiments in space plasma physics involved the release of lithium and barium plasmas in the solar wind. The resulting expanding artificial plasmas created diamagnetic cavities which were bounded on the sunward-side by a large shock-like magnetic field structure. Observations made by two spacecraft of the AMPTE (Active Magnetospheric Particle Tracer Explorers) mission revealed the presence of large-amplitude magnetic field oscillations. In this paper the authors show that these oscillations, which resemble finite-amplitude magnetosonic waves and have the characteristics of Adlam-Allen waves, can be described by a nonlinear wave equation, namely the Korteweg-de Vries equation.

2078 (RRK—87-4) **Decaying-particle universe models with nonzero cosmological constant and the galactic number count observation.** Tomita, Kenji; Sugiyama, Naoshi. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Mar 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750317/JAW.

Decaying-particle universe models with nonzero cosmological constant Λ are considered in connection with the recent observational [Galaxy number count N - redshift z] relation and it is shown that the best-fitted values of Λ and the density parameter Ω/ sub o/ depend on the decay time t/sub d/ : for H/sub o/t/sub d/ = 0.05, we get Ω/sub o/ = 0.494 and Λc/sup 2//(3H/sub o//sup 2/) = 0.046 and, if the model is required to be flat, Ω/sub o/ = 0.689 and Λc/sup 2//(3H/sub o//sup 2/) = 0.311. The cosmic ages are found to be of the order of or larger than 0.6/H/sub o/ in the fitted models. Moreover the nonlinear growth of the density perturbations is considered and the evolution of the baryon density is examined in several fitted models.

2079 (RRK—87-5) **Evolution from pure states into mixed states in de Sitter space.** Sakagami, Masa-aki. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Mar 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750316/JAW.

An attempt is made to clarify realization of a classical distribution from quantum fluctuations of the order parameter in the inflationary universe. We discuss destruction of quantum coherence associated with a state of the order parameter in models where it interacts with the environment. For that purpose, the time evolution of the reduced density matrix rho tilde, which is obtained by coarse-graining of the environment, is investigated. It is shown that off-diagonal elements of rho tilde decrease as the phase transition proceeds.

2080 **(RRK—87-8) Number count-redshift relation in a perturbed Friedmann universe.** Kasai, Masumi; Sasaki, Misao. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jun 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750302/JAW.

The number count-redshift relation in a linearly perturbed Friedmann universe is derived. It is shown that the resulting formula is invariant under any coordinate-gauge transformation and any affine parameter rescaling. Then it is applied to a perturbed Einstein-de Sitter model.

2081 **(RRK—87-12) Post-Newtonian equations of motion in an expanding universe.** Tomita, Kenji. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jun 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750303/JAW.

Equations of motion are derived in the post-Newtonian approximation in an expanding universe and their invariant property is examined.

2082 **Axions and stars.** Frieman, J.A.; Dimopoulos, S.; Turner, M.S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **36**: No. 8, 2201-2210(15 Oct 1987). Contract AC03-76SF00515.

The emission of light, noninteracting particles, such as axions and Majorons, modifies the structure and evolution of stars. We show that the main effects of such an energy loss are to raise the central temperature and luminosity of stars and to reduce their lifetimes. We clarify previous discussions of stellar axion bounds by directly relating the effects of axions to observable stellar parameters. The concordance of the standard model of the Sun with observations yields a self-consistent bound on the coupling of light pseudoscalars to electrons: g/sub phi//sub e/ $<5.4 \times 10^{-11}$. This corresponds to a lower limit on the Peccei-Quinn scale, (F/2X/sub e//sup '/) $\geq 10^7$ GeV, comparable to the usually quoted solar bound. The lifetime of helium-burning stars can be used to place a very stringent and confident bound on the axion scale, (F/2X/sub e//sup '/) $\geq 5.2 \times 10^8$ GeV, corresponding to g/sub phi//sub e/ $<9.3 \times 10^{-13}$. We also discuss the consequences of axion emission for the solar-neutrino problem, for the ages of globular clusters, and for terrestrial solar axion detectors. Since the axion luminosity scales as a lower power of temperature than the nuclear-energy-generation rate, axion emission has a stronger influence on cool stars. We discuss the resultant changes in the mass-luminosity relation for low-mass stars and the effects on the low-mass cutoff for main-sequence stars.

2083 **Bounds on hadronic axions from stellar evolution.** Raffelt, G.G.; Dearborn, D.S.P. (Institute for Geophysics and Planetary Physics, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] D: Particles and Fields;* **36**: No. 8, 2211-2225(15 Oct 1987).

We consider in detail the effect of the emission of "hadronic" invisible axions (which do not couple to electrons) from the interior of stars on stellar evolution. To this end we calculate plasma emission rates for axions due to the Primakoff process for the full range of conditions encountered in a giant star. Much attention is paid to plasma, degeneracy, and screening effects. We reconsider the solar bound by evolving a 1.0 M/sub sun/ star to solar age and lowering the presolar helium abundance so as to obtain the correct present-day luminosity of the Sun. The previous bound on the axion-photon coupling of G_{9}approx. <2.5 (corresponding to m/sub a/approx. <17 eV R where R is a model-dependent factor of order unity) is confirmed, where G_9 is the coupling constant G in units of 10/sup -9/ GeV/sup -1/. We then follow the evolution of a 1.3M/sub sun/ star from zero age to the top of the giant branch.

2084 **Nuclear response of water Cherenkov detectors to supernova and solar neutrinos.** Haxton, W.C. (Institute for Nuclear Theory, Department of Physics, FM-15, University of Washington, Seattle, Washington 98195). *Physical Review [Section] D: Particles and Fields;* **36**: No. 8, 2283-2292(15 Oct 1987).

I present a careful examination of the nuclear cross sections of low-energy neutrinos and antineutrinos in water Cherenkov detectors, and consider the implications for neutrinos from SN1987A. For thermal sources with Tapprox. >4—5 MeV (depending on the detector threshold) the reaction O(ν/sub e/,e⁻)F becomes the dominant mechanism for ν/sub e/ interactions, and at Tapprox. >7—9 MeV its rate exceeds that for (ν/sub e/,e) elastic scattering by at least an order of magnitude. This has important implications for proposed mechanisms for prompt emission of energetic ν/sub e/'s following neutronization. The O(nu-bar/sub e/,e⁺)N contribution remains a small correction to the dominant nu-bar/sub e/ +p→e⁺ +n rate, accounting for less than 10% of the events even at T = 10 MeV. Thus delayed β^- emission by /sup 16/N(tau/sub 1/2/ = 7.1 sec) cannot distort event timing. Observable neutral-current nuclear excitations are absent in water, but can be strongly excited in carbon-bearing liquid-scintillation detectors. Arguments are given that a burst poor in electron neutrinos and antineutrinos, but otherwise similar to those derived from standard supernovae theory, might produce comparable signals in the Mt. Blanc, Kamioka, and Irvine-Michigan-Brookhaven detectors. For solar neutrinos generated by ^{8}B β decay, reactions with trace quantities of /sup 18/O (two atoms per 10^4 electrons in natural water) account for approximately 10% of electron events. If it proves feasible to enhance the /sup 18/O content of a water Cherenkov detector, the hard spectrum of produced electrons would make an attractive charged-current signal.

2085 **Thermodynamics of higher dimensional black holes.** Accetta, F.S.; Gleiser, M. (Astronomy and Astrophysics Center, Enrico Fermi Institute, The University of Chicago, Chicago, Illinois 60637). *Annals of Physics (New York);* **176**: No. 2, 278-300(Jun 1987).

We discuss the thermodynamics of higher dimensional black holes with particular emphasis on a new class of spinning black holes which, due to the increased number of Casimir invariants, have additional spin degrees of freedom. In suitable limits, analytic solutions in arbitrary dimensions are presented for their temperature, entropy, and specific heat. In 5+1 and 9+1 dimensions, more general forms for these quantities are given. It is shown that the specific heat for a higher dimensional black hole is negative definite if it has only one non-zero spin parameter, regardless of the value of this parameter. We also consider equilibrium configurations with both massless particles and massive string modes. copyright 1987 Academic Press, Inc.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 2075

2086 **(AD-A—182597/5/XAB) Collaborative study of plasma irregularities from the HILAT satellite. Technical report (Final), 1 August 1983-31 July 1986.** Heelis, R.A. (Texas Univ., Richardson (USA). Center for Space Sciences). Jan 1987. 24p. NTIS, PC A02/MF A01.

Convective motion and evolution of high-latitude plasma irregularities are described. Data is utilized from the retarding-potential analyzer and the ion drift meter on board the HILAT satellite to determine the large-scale convective motion of the plasma. To obtain this information it is necessary to recover the satellite attitude data so that corrections for the look angle of the sensor with respect to the satellite can be made. The properties of the satellite attitude variation are described and the procedures for reducing the instrument data to geophysical parameters are outlined. Data from successive overlapping contacts of the satellite from three high-latitude stations are utilized to provide coverage of the entire high-latitude region. Then derivation of the electrostatic potential distribution is used to describe the global convection pattern. The details of this pattern and its effect on the transport of irregularities from their source region to other locations is studied.

2087 **(AD-A—183043/9/XAB) Large-scale plasma-density fluctuations measured with the HILAT satellite at 830-km altitude. Technical report.** Weimer, D.R. (Regis Coll., Weston, MA (USA). Research Center). 1 Apr 1987. 54p. (SCIENTIFIC—2). NTIS, PC A04/MF A01.

Measurements from the plasma monitor on the HILAT satellite were used to map the distribution of large-scale fluctuations in the density of plasma at high latitudes. Digital filtering was used to separate the original data into three frequency bands. The output from the middle band pass filter was used to count and map the distribution of large-scale plasma density enhancements. Maps of blob distribution are drawn as a function of magnetic local time and invariant latitude, for both low and high magnetic activity. To serve as a point of reference the same filtering and counting techniques are applied to measurements of the ion-drift velocity to show the distribution of electric-field fluctuations. Additionally, from the power levels measured at two different frequencies, the average spectral slopes of both the plasma density and electric field were mapped. The results show that large-scale plasma enhancements are created in the auroral zone and are transported away from the production regions by convection. Movement of blobs from the cusp to polar cap is very prominent. The spectral slope of the plasma density is significantly increased in the night side, from 23 to 2 hour magnetic local time. The intermediate-scale plasma irregularities appear to be dissipated in this region. Enhanced radio scintillations were measured with the HILAT radio beacon in the same locations.

2088 **(AD-A—183143/7/XAB) Mid-latitude scintillation model. Technical report, 1 November 1985-31 October 1986.** Robins, R.E.; Secan, J.A.; Fremouw, E.J. (Northwest Research Associates, Inc., Bellevue, WA (USA)). 31 Oct 1986. 75p. (NWRA—86-R004). NTIS, PC A04/MF A01.

Radiowave scintillation in the presence of ionospheric disturbances has the potential to disrupt numerous transionospheric radio and radar systems. This report describes development of a model characterizing the plasma density irregularities that produce scintillation in the naturally disturbed mid-latitude F layer. The model will be incorporated into Program WBMOD, which includes subroutines for computing both link geometry and scintillation indices, the latter by means of phase screen diffraction theory. Earlier versions of WBMOD, were based on extensive analysis of scintillation data collected in the auroral and equatorial zones in Wideband Satellite Mission. The model described herein is based on similarly extensive analysis of Wideband data from one mid latitude station and of data collected from HiLat satellite at another mid latitude station. The model describes irregularities at an effective height of 350 km that are isotropic across the geomagnetic field and elongated by a factor of 10 along the field and whose one-dimensional spatial power spectrum obeys a single regime power law with a (negative) spectral index of 1.5. The height-integrated spectral strength of the irregularities is modeled as a function apex latitude of the point. The report highlights a disagreement by a factor of approximately three between irregularity strength inferred from the two satellites in a region of overlap between the two mid-latitude stations.

2089 **(AD-A—183184/1/XAB) Auroral absorption models compared with riometer data. Final report.** Dave, N. (Naval Ocean Systems Center, San Diego, CA (USA)). Sep 1986. 50p. (NOSC/TD—1139). NTIS, PC A03/MF A01.

This report describes a study of several models for computer prediction of the levels of high-frequency radio-wave absorption in auroral regions. These predictive schemes are required in advanced versions of the PROPHET and related software, which is used for field strength predictions and for estimating the probability of communication between two points as a function of frequency of the signal, geographic location time, and geophysical indices. Modeling schemes published in the literature are reviewed and programmed, and comparisons are made. Lines of future research for improved predictive capacity are explored, including further study of riometer data at large values of K/sub p/, incorporation of an aurora-absorption model into an oblique-wave field-strength predictor, and an experimental program at high altitudes to measure field strengths for comparison with predictions.

2090 **(LA-UR—87-3261) Slow-mode shocks in the earth's magnetosphere.** Feldman, W.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 41p. (CONF-8708141—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000483/JAW.

From 6. meeting of solar wind; Estes Park, CO, USA (24 Aug 1987).

The locations and structure of slow-mode shocks in the earth's magnetosphere are reviewed. To date, such shocks have only been identified along the high latitude portions of the lobe-plasma sheet boundary of the geomagnetic tail. Although their intrinsic thickness is of the order of the upstream ion inertial length, they affect the internal state of a relatively much larger volume of surrounding plasma. In particular, they support a well-developed foreshock very similar to that observed upstream of the earth's bow shock, and a turbulent, strongly convecting downstream flow. They also figure importantly in the energy budget of geomagnetic substorms and produce effects which are closely analogous to much of the phenomenology known from solar observations to be associated with two-ribbon flares. 74 refs., 14 figs.

2091 **(N—87-26531, pp vp) Particle simulation of plasmas on the massively parallel processor.** Gledhill, I.M.A.; Storey, L.R.O. Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

Particle simulations, in which collective phenomena in plasmas are studied by following the self consistent motions of many discrete particles, involve several highly repetitive sets of calculations that are readily adaptable to SIMD parallel processing. A fully electromagnetic, relativistic plasma simulation for the massively parallel processor is described. The particle motions are followed in 2 1/2 dimensions on a 128 x 128 grid, with periodic boundary conditions. The two dimensional simulation space is mapped directly onto the processor network; a Fast Fourier Transform is used to solve the field equations. Particle data are stored according to an Eulerian scheme, i.e., the information associated with each particle is moved from one local memory to another as the particle moves across the spatial grid. The method is applied to the study of the nonlinear development of the whistler instability in a magnetospheric plasma model, with an anisotropic electron temperature. The wave distribution function is included as a new diagnostic to allow simulation results to be compared with satellite observations.

2092 **(PB—87-217691/XAB) Kiruna Geophysical Data: data summary 86/10-12, October-December 1986.** Thelin, B. (Kiruna Geophysical Inst. (Sweden)). 1987. 55p. NTIS, PC E04/MF E01.

See also report dated 1986, PB—87-158135.

Kiruna Geophysical Data is a collection of results of ground-based more-or-less continuous measurements of upper-atmosphere variables carried out at Kiruna Geophysical Institute. The objective with this data summary is to present current geophysical data, related to polar upper-atmospheric conditions, to those who require it for their research work. Ground measurements of upper-atmospheric parameters were conducted at Kiruna Geophysical Institute in the period for which data are presented in this report namely: Geomagnetism, Optical aurora, and Ionospheric ionization.

2093 **(SAND—87-1111) Tracking through turbulence at the Tonopah Test Range.** Weiss, J.D. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001448/JAW.

This report discusses the deleterious effects of turbulence on tracking images at the Tonopah Test Range and the means to overcome them. After reviewing the existing technologies used to compensate for optical aberrations in real-time and trying to restore sample images by using computer algorithms, we have concluded that raising the camera 20 to 30 ft is a simple, and probably the only, expedient available to overcome most of the turbulence problem at that facility. Previous experimental and theoretical studies, as well as our own photographic study, support that conclusion.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 1274, 1314, 1569, 1570, 1599, 1621, 2141, 2540, 2546

2094 **(AD-A—183033/0/XAB) Low-energy collision-induced energy transfer in the HeI_2 system.** Kim, Y.S.; Hutchinson, M.; George, T.F. (State Univ. of New York, Buffalo (USA)). 15 May 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Chemical Physics, Vol. 86, No. 10, 5515-5522(15 May 1987).

An investigation is made of vibrational energy transfer in low-energy collisions between He and vibrationally excited I_2. Taking into account the open-channel as well as closed-channel resonances and the coupling between the rotational and the vibrational motions, it is shown that the dynamics is not sensitive to the resonance position, and that the enhancement of the vibrational relaxation cross section at low collision energies is due to resonances (both closed-channel and open-channel), the anharmonicity of the I_2 molecule, and the long-range attractive force of the intermolecular potential.

2095 **(AD-A—183074/4/XAB) Excitation and ionization cross sections for electron-beam energy deposition in high-temperature air. Memorandum report.** Taylor, R.D.; Ali, A.W. (Naval Research Lab., Washington, DC (USA)). 9 Jul 1987. 56p. (NRL-MR—6013). NTIS, PC A04/MF A01.

Electron-impact excitation and ionization cross sections for N, N^+, O, and O^+ are provided. Electron kinetic energies range from threshold to > or = 5 MeV. Available experimental and theoretical are summarized and compared.

2096 **(AD-A—183166/8/XAB) Crossed molecular-beam studies. Final report, 1 October 1981-30 September 1984.** Herschbach, D.R. (Harvard Univ., Cambridge, MA (USA). Dept. of Chemistry). Apr 1987. 33p. NTIS, PC A03/MF A01.

This report summarizes three of investigations: 1) studies of van der Waals collision dynamics, 2) laser spectroscopy study of rotational vibrational relaxations, and 3) angular correlations in chemical reactions. A crossed molecular-beam apparatus was used to study several van der Waals bond-exchange reactions. These collisions involving extremely weak interactions were found to have product velocity distributions that resemble those from several ion molecular reactions that occur at very high collision energy. This led to the theoretical development of a scattering model which should be applicable to a wide range of reactive and inelastic collision processes at kinetic energies higher than the bond strengths. In another effort, laser-induced fluorescence experiments were performed to measure the rotational and vibrational temperatures of molecular iodine seeded in beams of helium, argon, or nitrogen expanded from a supersonic nozzle. The results demonstrated the utility of seeded iodine fluorescence as a diagnostic for pulse shape and collisional relaxation in pulsed supersonic beams. Lastly, theoretical calculations dealing with rotational orientation in molecular collisions resulted in the formulation of a correlation analysis which offers a means to obtain information about collision dynamics that would otherwise be lost by averaging over the initial impact parameters and molecular orientations.

2097 **(AD-A—183365/6/XAB) Electron-impact phenomena in vuv photoionization mass spectroscopy. Interim technical report.** Huth, T.C.; Denton, M.B. (Arizona Univ., Tucson (USA). Dept. of Chemistry). 26 May 1987. 25p. (TR—45). NTIS, PC A02/MF A01.

Electron-impact ionization arising from acceleration of stray electrons in the ion source is a major interference in photoionization mass spectrometry with vacuum-ultraviolet sources. Results are presented which show that most of this ionization is caused by low-energy secondaries generated when stray primaries are collected by the ion-source electrodes. The primaries are produced mainly by interaction of scattered vuv radiation with metal surfaces. The low-energy stray-electron impact process can produce molecular ions as the only detectable electron impact features in the photoionization mass spectrum, especially for aromatic compounds. These features are not immediately distinguishable from photoions in the spectrum. When time-of-flight mass analysis is employed, the distinction can be made simply through adjustment of ion-source conditions. The method for accomplishing this is described and demonstrated.

2098 **(BONN-HE—86-06) Spectra of quantum chains with free boundary conditions and Virasoro algebras.** Gehlen, G. v.; Rittenberg, V. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Mar 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753305/JAW.

At the critical point the spectra of quantum chains with periodic and twisted boundary conditions are described by irreducible representations of two Virasoro algebras with the same central charge. We show that in the case of free boundary conditions, the spectra can be understood in terms of irreducible representations of a single Virasoro algebra. For the Ising and the three-states Potts models, the corresponding irreducible representations are identified.

2099 **(BONN-HE—86-20) Conformal structure in the spectrum of an altered quantum Ising chain.** Henkel, M.; Patkos, A. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Jul 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753306/JAW.

The Ising model with an infinite line of defects is mapped onto a strip with two defect lines. The Hamiltonian spectrum is studied at the bulk critical point. Its exact diagonal form is found for an infinite number of sites. The spectrum of physical excitations contains an infinite number of primary fields, while the leading ground state energy correction is independent of the defect strength. A novel algebraic structure interpolating between those belonging to periodic and free boundary conditions is signalled.

2100 **(CONF-8710159—1) Cross sections for atomic displacements in solids by fast positrons.** Oen, Ordean S. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014947/JAW.

From 12. international conference on atomic collisions in solids; Okayama, Japan (12 Oct 1987).

The Mott series has been used to calculate the cross section for atomic displacements produced in elastic collisions between relativistic positrons and atomic nuclei. The Kinchin and Pease displacement model was used. Several elements spanning the atomic table were treated using positron energies ranging from threshold to several tens of MeV. The results are compared with previous calculations for relativistic electrons. It is found that for the same energy and atomic number the positron cross sections are always smaller (up to a factor of 5 or more). It is also found that the McKinley-Feshach formula which is frequently used in radiation damage analysis is even less reliable for positrons than for electrons. 9 refs.

2101 **(DESY-SR—86-12) Bound-free fluorescence of rare gas hydrides.** Moeller, T.; Beland, M.; Zimmerer, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik). Dec 1986. 17p. NTIS, PC E07; NTIS as TIB/B87-11107.

Bound-free fluorescence of HeH, NeH, ArH, KrH and XeH is reported. The excimers are formed in a photochemical reaction between H/sub 2/ (C /sup 1/PI/sub u/, B /sup 1/Σ/sub u//sup +/) and rare gases using synchrotron radiation for the excitation of H/sub 2/. Broad fluorescence continua in the near UV are observed and assigned to the rare gas hydride transition B /sup 2/PI- > X /sup 2/Σ/sup +/. In the case of NeH, also the A /sup 2/Σ/ sup +/ seems to contribute to the fluorescence spectrum. Experimentally derived binding energies of the B-state and bound-free spectra of HeH and ArH are in a good agreement with recently performed ab initio calculations. Radiative lifetimes, quenching cross sections and formation cross-sections are determined.

2102 **(GSI—87-39-Prepr.) Positron lines from subcritical heavy ion-atom collisions.** Koenig, W.; Bosch, F.; Kienle, P.; Kozhuharov, C.; Tsertos, H.; Berdermann, E.; Huchler, S.; Wagner, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). Jul 1987. 39p. Alos published in Z. Phys., A (Oct 1987) Vol. 328(2) p. 129-145.

Positron lines were observed in heavy ion - atom collisions at bombarding energies close to the Coulomb barrier in subcritical systems with the sum of the atomic numbers of the colliding nuclei Z/sub x/ = Z/sub 1/ + Z/sub 2/ being smaller than Z/sub x/ = 172. Each collision system studied, /sup 208/Pb + /sup 208/Pb (Z/sub x/ = 164), /sup 238/U + /sup 181/Ta (Z/sub x/ = 165), and /sup 238/U + /sup 197/Au (Z/sub x/ = 171), exhibits the emission of two positron lines with Z/sub x/ - independent c.m. energies of ≅ 258 keV and ≅ 340 keV, and with widths of about 30 keV, superimposed on continuous positron spectra from nuclear pair decay and pair emission, induced by the time changing Coulomb field of the collision. The production cross section of the e/sup +/-lines rises with a high power of Z/sub x/ {proportional to Z/sub x//sup 22/), which is comparable to the Z/sub x//sup 20/-dependence for the collision induced positrons.

2103 **(INIS-mf—10720) Calculation of interatomic potentials in the range of submolecular nuclear distances.** Hartung, H. (Kassel Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 18 - Physik). 13 Feb 1985. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753302/JAW.

Methods for calculating interatomic potentials at internuclear distances, at which the inner shells of the atomic collision systems strongly overlap, are discussed. Thus the influence of the inner electron shells on the interatomic interactions can be understood. (BBOE).

2104 **(IPNO—85-07) IPN and AFI collaboration balance. The SIS source (Crysis).** Goldstein, C. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1985. 41p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752720/JAW.

The fabrication and development of a source with confined electron beam (EBIS) is the result of a collaboration between IPN (Institut de Physique Nucleaire) and AFI (Forskningstitutet for Atomfysik) First tests have confirmed the good operation of the whole elements. A critical balance is made, and conclusions are drawn.

2105 **(KFK—4156) Interactions of a cesium atomic beam with helium-3 and helium-4 cluster beams.** Gspann, J.; Ries, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernverfahrenstechnik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Dec 1986. 58p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753284/JAW.

Dissertation. Submitted by R. Ries.

/sup 3/He and /sup 4/He clusters with 10/sup 4/ to 10/sup 7/ atoms allow to study very small quantities of quantum fluids. The temperature of /sup 4/He clusters is lower than the λ-temperature so that superfluidity can occur. /sup 3/He clusters, however, are certainly not superfluid. Absolute measurements of the total scattering of a cesium atomic beam by /sup 3/He and /sup 4/He cluster beams show for both isotopes within the experimental error an independence of the total scattering cross section on the relative velocity. The results can be explained for /sup 3/He clusters as well as for /sup 4/He clusters by assuming the geometrical cross section of the clusters with an additional van-der-Waals interaction zone as the total scattering cross section and, additionally, a few per mille of uncondensed helium atoms inside the cluster beam. This holds even for relative velocities smaller than the Landau critical velocity below which the creation of elementary excitations in bulk superfluid /sup 4/He is impossible. Differential scattering measurements indicate that at least part of the Cs atoms impinging on /sup 4/He clusters is carried along with the clusters.

2106 **(LA-UR—87-3056) Energy balance in laser-irradiated vaporizing droplets.** Zardecki, A.; Armstrong, R.L. (Los Alamos National Lab., NM (USA); New Mexico State Univ., Las Cruces (USA). Applied Laser Optics Group). 8 Sep 1987. Contract W-7405-ENG-36. 7p. (CONF-8706199—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000525/JAW.

From CRDEC scientific conference on obscuration and aerosol research; Aberdeen, MD, USA (1 Jun 1987).

We analyze the interactions of atmospheric aerosols with a high-energy laser beam. The energy balance equation allows us to compute the conversion of the pulse energy into temperature increase, vaporization, conduction, and convection. We also include the shrinkage term whose significance has recently been discussed by Davies and Brock.

2107 **(LAL-RT—86-04) Photocurrent emission from cusp photocathodes.** Boussoukaya, M.; Bergeret, H.; Chehab, R.; Le Duff, J.; Leblond, B.; Franco, M. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Sep 1986. 26p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752706/JAW.

Results of pulsed photofield emission from two different tungsten needles and from a brush of about 10/sup 3/ needles are given. Photoemitted currents were obtained using infrared, green and ultra violet rays from a nanosecond Nd: Yag laser. High emitted current densities were obtained (more than 10/sup 6/ A/cm/sup 2/) and photo-electric yields of more than 1 were reached in green and U.V. lights.

2108 **(LBL—22593) Extending the range of low energy electron diffraction (LEED) surface structure determination: Co-adsorbed molecules, incommensurate overlayers and alloy surface order studied by new video and electron counting LEED techniques.** Ogletree, D.F. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 641p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88001401/JAW.

LEED multiple scattering theory is briefly summarized, and aspects of electron scattering with particular significance to experimental measurements such as electron beam coherence, instrument response and phonon scattering are analyzed. Diffuse LEED experiments are discussed. New techniques that enhance the power of LEED are described, including a real-time video image digitizer applied to LEED intensity measurements, along with computer programs to generate I-V curves. The first electron counting LEED detector using a "wedge and strip" position sensitive anode and digital electronics is described. This instrument uses picoampere incident beam currents, and its sensitivity is limited only by statistics and counting times. Structural results on new classes of surface systems are presented. The structure of the c(4 x 2) phase of carbon monoxide adsorbed on Pt(111) has been determined, showing that carbon monoxide molecules adsorb in both top and bridge sites, 1.85 +- 0.10 A and 1.55 +- 0.10 A above the metal surface, respectively. The structure of an incommensurate graphite overlayer on Pt(111) is analyzed. The graphite layer is 3.70 +- 0.05 A above the metal surface, with intercalated carbon atoms located 1.25 +- 0.10 A above hollow sites supporting it. The ($2\sqrt{3}$ x 4)-rectangular phase of benzene and carbon monoxide coadsorbed on Pt(111) is analyzed. Benzene molecules adsorb in bridge sites parallel to and 2.10 +- 0.10 A above the surface. The carbon ring is expanded, with an average C-C bond length of 1.72 +- 0.15 A. The carbon monoxide molecules also adsorb in bridge sites. The structure of the ($\sqrt{3}$ x $\sqrt{3}$) reconstruction on the (111) face of the α-CuAl alloy has been determined.

2109 **(LYCEN—8563) Experimental study of the dissociation of 100-600 KeV hydrogen cluster ions in an argon gas target.** Chevallier, M.; Clouvas, A.; Frischkorn, H.J.; Gaillard, M.J.; Poizat, J.C.; Remillieux, J. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Sep 1985. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752726/JAW.

We have studied the break-up of accelerated hydrogen cluster ions passing through an argon gas target. The absolute dissocia-

tion cross section has been measured for a wide variety of H/sub n//sup +/ (odd masses only) cluster ions, with n between 5 and 23 and with projectile velocities ranging from 1.5 to 5 x 10/sup 8/ cm/s. We discuss the dissociation processes and the dependence of their cross-sections upon the cluster mass and velocity.

2110 **(MPQ—116) Spectroscopy of helium hydride and triatomic hydrogen molecules.** Ketterle, W. (Max-Planck-Institut fuer Quantenoptik, Garching (Germany, F.R.)). Jul 1986. 156p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87753293/JAW.

Helium hydride and triatomic hydrogen has been produced by charge exchange between fast mass selected beams of molecular ions and alkali vapor. Using this method, the first discrete spectra of helium hydride were obtained. Fine electronic transitions with resolved rotational structure were observed in the visible and near infrared. Four isotopic mixtures were studied. Furthermore the first lifetime measurement of triatomic hydrogen states were performed and compared to theoretical predictions.

2111 (N—87-26692, pp 16) **Vibrational and rotational analysis of the emission spectra of the arc jet flow.** Blount, C.E. Jun 1987. NTIS, PC A16/MF A01. (NASA-CR—171984-VOL-1; NAS—1.26:171984-VOL-1).

In National Aeronautics and Space Administration (NASA)/ American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, Volume 1.

Applying atomic and molecular physics to the analysis of the radiation emitted from the arc jet flow provides a means for determining the species and excitation temperature of the constituents of the flow. A rotational and vibrational analysis of the spectra obtained from the radiation emitted in the shock layer and in the free stream of the jet flow was performed, specifically, in the shock layer bands of the First Negative Group of ionized molecular nitrogen and in the free stream of the gamma-system of nitric oxide.

2112 **(PB—87-213518/XAB) Instrument-independent CAD (collisionally-activated dissociation) spectral data bases: absolute cross-section measurements in qqq (triple quadrupole) instruments.** Martinez, R.I.; Dheandhanoo, S. (National Bureau of Standards, Washington, DC (USA). Center for Chemical Physics). 5 Feb 1987. 9p. NTIS, PC A05/MF A01.

Included in Jnl. of Research of the National Bureau of Standards, Vol. 92, No. 3, 229-237(May-Jun 1987).

The energy dependence of the cross section for the symmetric (resonant) charge-transfer reaction Ar(1+) (Ar,Ar) Ar(1+) was measured in the triple quadrupole (QQQ) tandem mass spectrometer. Results are discussed.

2113 **(PUC-TN—15/84) Deuteron-and alpha particle-induced K-shell ionisation of W and Au atoms.** Freire Junior, F.L.; Montenegro, E.C.; Pinho, A.G. de; Sigaud, G.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703770/JAW.

Deuteron - and alpha particle - induced K-shell ionisation cross sections for W and Au were obtained from thick-target measurements for low impact velocities. They were compared to proton-induced cross sections in the same range of velocities. Equal-velocity cross sections ratios are a very stringent test to the corrections incorporated to the PWBA calculations. The σ/sub d// σ/sub p/ data presented in this paper sheds some light on the Coulomb-deflection corrections discussed in the literature. The consequences of the inelastic character of the ionisation process are thoroughly examined.

2114 **(SAND—86-2408) Electron Beam Test System high intensity/short pulse mode.** Croessmann, C.D.; Gilbertson, N.B.; McDonald, J.M.; Whitley, J.B. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001785/JAW.

The Electron Beam Test System was successfully modified to deposit power densities in the range of 100's kW/cm^2 for a few milliseconds on an area of 0.1 cm^2. This modification was made in response to a need for an experimental apparatus that could provide intense power deposition on a short time scale. Modifications to computer software and the electron gun electronics were necessary to provide a versatile method of moving and focusing the electron beam on a millisecond time scale. The resulting beam operation was demonstrated to provide the necessary parameters in a reproducible fashion. It was shown that an infrared camera could be used to provide measurements of the surface temperature during an energy deposition of only a few milliseconds. The correlation of the vaporization and melting of the target material with the energy deposition or surface temperature during events such as plasma disruptions or arcing is possible.

2115 **(SAND—87-2359C) BUCKSHOT benchmarking and Delphi applications.** Shokair, I.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-8709146—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000363/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

The code BUCKSHOT which is an electrostatic particle simulation code has been developed and is being used at Sandia to study effects of the ion hose instability on electron beam propagation in the Ion-Focused Regime (IFR). The code solves the equations of motion in the plane transverse to the direction of propagation. First, we consider benchmarking the code against a problem for which the exact solution is known, namely linear ion hose growth in the limit of a rigid beam-channel system. We then consider beam propagation in the absence, and in the presence, of an external transverse magnetic field, for Delphi parameters. 4 refs.

2116 **(SAND—87-2383C) High efficiency generation of 130-nm radiation from sum-frequency mixing in Hg.** Hadley, G.R.; Smith, A.V.; Alford, W.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-8709146—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013714/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

The formation of an upper atmospheric ionization channel for electron beam propagation, as envisioned in the DELPHI program, requires high-intensity laser sources to accomplish the ionization of atomic oxygen. For one of the ionization schemes being examined, a strong source at 130.2 nm is required in order to excite oxygen atoms into the ^{3}S state, from which they are easily ionized using more readily available and lower-power lasers. We are presently investigating the use of two-photon-resonant four-wave mixing in atomic Hg vapor as a means of efficiently generating the necessary 130 nm light. This particular system is attractive primarily because the relevant oscillator strengths are high enough to allow reasonable (>10%) conversion efficiencies without resorting to focused geometries. Thus, the results of laboratory experiments may be directly scaled to higher powers.

2117 **(UCID—21152) Interim report of the J = 0 task force.** Whitten, B.L.; Hazi, A.U.; Keane, C.J.; London, R.A.; MacGowan, B.J.; Phillips, T.W.; Rosen, M.D.; Whelen, D.A. (Lawrence Livermore National Lab., CA (USA)). 25 Aug 1987. Contract W-7405-ENG-48. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001326/JAW.

The J = O task force was instituted to analyze the theoretical and experimental information available which is relevant to solving the J = O anomaly in the neon-like selenium x-ray laser. We summarize what is presently known about neon-like x-ray lasers from experiments at LLNL and NRL, and what is known about the plasma conditions of the x-ray laser plasma. We propose several hypotheses to explain the J = O anomaly, and discuss the arguments for and against each. Finally, we propose a series of experiments to further elucidate the solution to this problem. 30 refs.

2118 **(UCRL—96494) XUV emission features from the Livermore soft x-ray laser experiments.** Eckart, M.J.; Scofield, J.H.; Hazi, A.U. (Lawrence Livermore National Lab., CA (USA)). 8 Sep 1987. Contract W-7405-ENG-48. 6p. (CONF-8709143—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000420/JAW.

From International colloquium on UV and X-ray spectroscopy; Beaulieu-Sur-Mer, France (9 Sep 1987).

The measured wavelengths in the soft x-ray region for 3p to 3s and 3d to 3p transitions in neon-, sodium-, and magnesium-like selenium are presented. The experimental results for the neon-like ions are compared to theoretical wavelength values and with values extrapolated along the isoelectronic sequence. The ions were contained in a plasma heated in a line-focus of a Nd-glass laser. The measurements were made with a time-gated microchannel-plate-intensified grazing incidence spectrograph.

2119 **(UCRL—97325) Wavelengths of the 3p-3d transitions of the Co- and Fe-like ions: The effects of electron correlation.** Chen, Mau Hsiung. (Lawrence Livermore National Lab., CA (USA)). 2 Sep 1987. Contract W-7405-ENG-48. 6p. (CONF-8709143—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000219/JAW.

From International colloquium on UV and X-ray spectroscopy; Beaulieu-Sur-Mer, France (9 Sep 1987).

The experimental observations of the $3p^6\ 3d^9\ {}^2D$ - $3p^5\ 3d^{10}\ {}^2p$ transitions of the Co-like ions and $3p^6\ 3d^8\ {}^3F_4$ - $3p^5\ 3d^9\ {}^3F_3$ of the Fe-like ions have recently been extended to highly charged ions of heavy elements up to uranium (Z = 92). A comparison between the observed energies and calculated values from the Dirac-Fock model indicated persistent discrepancies of 3 to 4 eV for all ions. Systematic multiconfiguration Dirac-Fock calculations for these transitions have been carried out with emphases on the effects of electron correlation. The previously found discrepancies theory and experiment have mostly removed after the inclusion of the electron-electron correlation effects in the theoretical calculations. 13 refs.

2120 **Electronic states of Pt_2.** Balasubramanian, K. (Department of Chemistry, Arizona State University, Tempe, Arizona 85287-1604). *Journal of Chemical Physics;* **87**: No. 11, 6573-6578(1 Dec 1987).

Complete active space MCSCF (CASSCF) followed by first-order configuration interaction (FOCI) calculations are carried out on low-lying electronic states of Pt_2. The spin—orbit interaction is introduced through a relativistic configuration interaction method. Twenty-two low-lying ω—ω states with T/sub e/ < 15 000 cm^{-1} and 11 λ—s states with T/sub e/ < 3189 cm^{-1} are found. The nature of all these electronic states is discussed. The calculated R/sub e/ values of all the electronic states are between 2.4 and 2.6 A. The spin—orbit effects are found to be significant for the electronic states of Pt_2. The CASSCF/FOCI dissociation energies of the strongest-bound states in the absence of spin—orbit interaction are calculated to be about 2.3 eV. The spin—orbit interaction decreases the D/sub e/. The dissociation energies of the strongest-bound states in the presence of spin—orbit interaction are about 1.85—1.95 eV.

2121 **Response of the ^1P/sup o/ resonance near n = 3 in the H^- continuum to external electric fields.** Cohen, S.; Bryant, H.C.; Harvey, C.J.; Stewart, J.E.; Butterfield, K.B.; Clark, D.A.; Donahue, J.B.; MacArthur, D.W.; Comtet, G.; Smith, W.W.; and others. (Drexel University, Philadelphia, Pennsylvania 19104). *Physical Review [Section] A: General Physics;* **36**: No. 10, 4728-4736(15 Nov 1987).

The response to external electric fields of the ^1P/sup o/ resonance "dip" in the H^- photodetachment continuum cross section below the n = 3 hydrogenic excitation threshold is investigated. Using the relativistic ($\beta = 0.806$) 650-MeV H^- beam at the Clinton P. Anderson Meson Physics Facility (LAMPF) in Los Alamos, the fourth harmonic (266 nm) of a Nd:YAG laser (where YAG denotes yttrium aluminum garnet) is Doppler shifted to provide a continuously tunable photon beam in the rest frame of the ions. The magnetic field from pulsed Helmholtz coils, surrounding the photon-H^- interaction point provides a Lorentz-transformed barycentric electric field. As the magnitude of the external field is increased, there is no observed shift in the photon energy to excite the resonance E/sub o/, 12.650 +- 0.001 eV, until quenching occurs at a field strength of 2.36 MV/cm. The effective strength of the resonant state is consistent with a linear decrease with increasing field. The line shape index q is constant within statistical uncertainty, until the resonance disappears. There is evidence that the width of the resonance remains constant at fields below 1.25 MV/cm. It then broadens at higher fields before the resonance quenches.

2122 **Interference effects in electron-ion recombination. I. Resonance channels only.** LaGattuta, K.J. (Los Alamos National Laboratory B-257, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **36**: No. 10, 4662-4666(15 Nov 1987).

The Feshbach formalism is employed in investigations of the effects of interacting and/or overlapping resonances on dielectronic recombination. Model systems are considered, and the problem of singly charged target ions is discussed. Small reductions in dielectronic recombination cross sections are found to occur for these systems. Comparison is made with the results of multichannel quantum-defect theory calculations.

2123 **Dynamical symmetries of the perturbed hydrogen atom: The van der Waals interaction.** Alhassid, Y.; Hinds, E.A.; Meschede, D. (A.W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review Letters;* **59**: No. 14, 1545-1548(5 Oct 1987).

We have studied theoretically the spectrum of hydrogen atoms subjected to a certain class of perturbations, including the van der Waals and the diamagnetic interactions. We find a universal adiabatic invariant for this class. In special cases the system exhibits dynamical symmetry and an analytic spectrum. The pattern of energy levels in general can be understood in terms of the adjacent symmetries.

2124 **Tunable resonant sensing means to sense a particular frequency in a high energy charged particle beam and generate a frequency-domain signal in response.** Nakamura, Michiyuki; Nolan, M.L. (to Dept. of Energy). US Patent Application 6-909,669. 22 Sep 1986. 21p. Contract AC03-76SF00098. DE88000869 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000869/JAW.

A frequency domain sensing system is disclosed for sensing the position of a high energy beam of charged particles traveling within a housing which comprises a plurality of sensing means positioned in the wall of the housing radially around the axis of the beam. Each of the sensing means further comprising a first electrode means of predetermined shape received in a bore in the housing to define a fixed capacitance and inductance means attached to the electrode to provide an inductance for the sensing means which will provide an LC circuit which will resonate at a predetermined frequency known to exist in the beam of charged particles. The sensing means are further provided with tuning means to vary the amount of said inductance to tune the sensing means to the predetermined frequency prior to transmission of the signal to signal detection circuitry.

2125 **Role of indirect processes in electron-impact ionization of multicharged ions.** Gregory, D.C. (Oak Ridge National Lab., TN). pp 205-214 of Electronic and atomic collisions. Invited papers. Lorents, D.C.; Peterson, J.R.; Meyerhof, W.E. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-850701—).

From 14. international conference on the physics of electronic and atomic collisions; Palo Alto, CA, USA (24 Jul 1985).

Recent studies of electron impact ionization in this laboratory are discussed with emphasis on the role of indirect processes. Examples are used to illustrate the importance of excitation-autoionization (Ti^{2+} and Al^{2+}), autoionizing metastable ions in the Na isoelectronic sequence, multiple ionization (triple ionization of Xe^{9+}), the relative importance of indirect ionization with increasing charge in the Mg isoelectronic sequence, and the extension of ionization measurements to higher-charged target ions (Fe^{9+}). 21 references, 6 figures, 1 table.

2126 Doubly differential cross sections of collision-produced forward electron emission. Elston, S.B. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). pp 331-344 of Electronic and atomic collisions. Invited papers. Lorents, D.C.; Peterson, J.R.; Meyerhof, W.E. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-850701—).

From 14. international conference on the physics of electronic and atomic collisions; Palo Alto, CA, USA (24 Jul 1985).

The velocity space distribution of electrons emitted near the forward direction from collisions involving fast, highly stripped oxygen ions with gaseous and solid targets is presented and described in terms of multipole moments of the ejected charge distribution, which permits direct comparison with recent theory. The results are from a novel apparatus permitting rapid and efficient data acquisition by employing position-sensitive electron detection to combine emission angle definition with conventional electrostatic spectrometry. Excellent agreement is obtained between distributions observed for electron loss to projectile continuum processes and recent theory in the case of argon targets; less favorable results for simpler helium targets may indicate the need for theoretical study of higher order inelastic processes in that case. The multipole content observed with a solid target is consistent with a conceptual model of convoy electron production dominated by electron loss from the projectile within the bulk of the target and may signify the importance of steady-state production of excited states within the bulk solid. 26 references, 4 figures, 2 tables.

2127 Atom capture and loss in ion molecule collisions. Breinig, M.; Lasley, S.E.; Gaither, C.C. III. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). pp 555-560 of Electronic and atomic collisions. Invited papers. Lorents, D.C.; Peterson, J.R.; Meyerhof, W.E. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-850701—).

From 14. international conference on the physics of electronic and atomic collisions; Palo Alto, CA, USA (24 Jul 1985).

Progress is reported in measuring the energy and angular distribution of protons emerging with velocity close to the beam velocity from the target region when Ar^+ beams collide with a CH_4 target and ArH^+ beams collide with a He target at asympotically high speeds. The protons result from the transfer of a target constituent to the projectile (atom capture) or from the dissociation of the projectile molecule in the collision (atom loss). For atom capture processes the Thomas peak is clearly observed. 10 references, 3 figures.

2128 Inelastic and reactive collisions with polarized excited Na atoms. Schmidt, H.; Hertel, I.V.; Lee, Y.T. (Freie Univ. Berlin, Germany, F.R.; Lawrence Berkeley Lab., CA; California Univ., Berkeley). pp 561-568 of Electronic and atomic collisions. Invited papers. Lorents, D.C.; Peterson, J.R.; Meyerhof, W.E. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-850701—).

From 14. international conference on the physics of electronic and atomic collisions; Palo Alto, CA, USA (24 Jul 1985).

Polarization effects in inelastic collisions of laser state-prepared Na(3^2P, M/sub J/) with Na^+ leading to Na(3^2D) or Na(3^2S) are discussed for the energy range E/sub cm/ = 5-47.5eV. Studies with linearly polarized light can be explained with a simple locking model of the Na(3p)-orbital. The investigations employing circularly polarized light are a very sensitive test of the models describing the nonadiabatic angular momentum coupling between electronic and nuclear motion. The dynamical effects of the electronic spin on the angular momentum transfer are discussed. Recent crossed-beam experiments on the Na + O_2 -> NaO + O reaction in the energy range E/sub cm/ = 0.3-0.8eV show a pronounced dependence on the electronic symmetry of Na. 17 references, 11 figures.

2129 Description of the intense, low energy, monoenergetic positron beam at Brookhaven. Lynn, K.G.; Mills, A.P. Jr.; Roellig, L.O.; Weber, M. (Brookhaven National Lab., Upton, NY; AT and T Bell Labs., Murray, NJ; City College, New York, NY). pp 227-232 of Electronic and atomic collisions. Invited papers. Lorents, D.C.; Peterson, J.R.; Meyerhof, W.E. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-850701—).

From 14. international conference on the physics of electronic and atomic collisions; Palo Alto, CA, USA (24 Jul 1985).

An intense ($4x10^7$ s^{-1}), low energy (—1.0 eV), monoenergetic ($\Delta E \simeq 75$ meV) beam of positrons has been built at the Brookhaven National Laboratory. This flux is more than 10 times greater than any existing beam from radioactive sources. Plans are underway to increase further the flux by more than an order of magnitude. The intense low energy positron beam is made by utilizing the High Flux Beam Reactor at Brookhaven to produce the isotope ^{64}Cu with an activity of 40 curies of positrons. Source moderation techniques are utilized to produce the low energy positron beam from the high energy positrons emitted from ^{64}Cu. 31 references, 7 figures.

2130 A supersymmetry among atomic spectra. Kostelecky, V.A.; Nieto, M.M. (Los Alamos National Lab.). pp 478 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors obtain the supersymmetric partner of the quantum mechanical hydrogenic radial equation, for fixed values of the orbrital angular momentum quantum number. In the absence of electron-electron interactions, the s-orbital spectra of hydrogen and lithium, and the p-orbital spectra of boron and aluminum, are found to be related by a supersymmetry. They extend the supersymmetry to interrelate the spectra of all atoms within a Group of the periodic table. A similar analysis is performed for ionic spectra. Experimental values of the energy level separations support these relationships.

2131 ASYTOP - a program for detailed analysis of gas phase magnetic resonance spectra of asymmetric top molecules. Sears, T.J. (Brookhaven National Lab., Upton, NY). *Computer Physics Communications;* **34**: 123-133(1984). Contract AC02-76CH00016.

The rovibrational energy levels of an asymmetric top free radical are the eigenvalues of the effective molecular Hamiltonian operator for the electronic state in question. The matrix of the modal Hamiltonian is constructed in a fully coupled, parity conserving basis and brought to diagonal form.The relevant eigenvalues and vectors are selected, and transition frequencies and electric dipole intensities calculated as a function of an applied magnetic field. Hyperfine effects for only one nucleus of non-zero spin are included. Typical running time depends on type of calculation requested and the complexity of the molecular problem in terms of nuclear and electron spin. A typical single data point for a molecule in a doublet electronic state and not containing a nucleus with nonzero spin requires approximately 25 s of VAX 11/730 CPU time.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 2503, 2504, 2595

2132 (DOE/ER/10498—3-7/87) Transport properties of multiphase systems: Progress report. Stell, G. (State Univ. of New York, Albany (USA). Research Foundation). Jul 1987. Contract AC02-79ER10498. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014978/JAW.

The research covered to Sung-Stell transport theory of binary fluid mixtures, kinetic variational theory, kinetic reference theory, and critical behavior in fluids. (DLC)

2133 (LA—11088-T) Statistical theory of turbulent incompressible multimaterial flow. Kashiwa, B. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 217p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88000435/JAW.

Interpenetrating motion of incompressible materials is considered. "Turbulence" is defined as any deviation from the mean motion. Accordingly a nominally stationary fluid will exhibit turbulent fluctuations due to a single, slowly moving sphere. Mean conservation equations for interpenetrating materials in arbitrary pro-

portions are derived using an ensemble averaging procedure, beginning with the exact equations of motion. The result is a set of conservation equations for the mean mass, momentum and fluctuational kinetic energy of each material. The equation system is at first unclosed due to integral terms involving unknown one-point and two-point probability distribution functions. In the mean momentum equation, the unclosed terms are clearly identified as representing two physical processes. One is transport of momentum by multimaterial Reynolds stresses, and the other is momentum exchange due to pressure fluctuations and viscous stress at material interfaces. Closure is approached by combining careful examination of multipoint statistical correlations with the traditional physical technique of κ-ϵ modeling for single-material turbulence. This involves representing the multimaterial Reynolds stress for each material as a turbulent viscosity times the rate of strain based on the mean velocity of that material. The multimaterial turbulent viscosity is related to the fluctuational kinetic energy κ, and the rate of fluctuational energy dissipation ϵ, for each material. Hence a set of κ and ϵ equations must be solved, together with mean mass and momentum conservation equations, for each material. Both κ and the turbulent viscosities enter into the momentum exchange force. The theory is applied to (a) calculation of the drag force on a sphere fixed in a uniform flow, (b) calculation of the settling rate in a suspension and (c) calculation of velocity profiles in the pneumatic transport of solid particles in a pipe.

2134 **(LA-UR—87-3163) Three-dimensional, Free-Lagrange hydrodynamics.** Trease, H. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 22p. (CONF-8704208—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000494/JAW.

From Numerical applications for particle methods meeting; Los Alamos, NM, USA (6 Apr 1987).

This paper describes the algorithms that make up a 3-D version of the Free-Lagrange Method. The basic method involves the explicit integration of the fluid flow equations over control volumes formed by Voronoi cells. A Voronoi cell is an arbitrary, convex polyhedron that has plane polygon faces. The "nearest" neighbors of any given mass point are identified by noting the mass point that lies on the opposite side of a given Voronoi face. The nearest neighbors of a mass point are allowed to change in response to the (Lagrange) motion of the mass points. This implies that the mesh reorganizes itself as the mass points move with the fluid motion.

2135 **Modulated convection at high frequencies and large modulation amplitudes.** Swift, J.B.; Hohenberg, P.C. (Department of Physics and Center for Nonlinear Dynamics, University of Texas at Austin, Austin, Texas 78712). *Physical Review [Section] A: General Physics;* **36**: No. 10, 4870-4875(15 Nov 1987).

Modulated Rayleigh-Benard convection is analyzed for high frequencies and large modulation amplitudes. The linear theory of Gershuni and Zhukhovitskii is generalized to the nonlinear domain, and a subcritical bifurcation to convection is found in agreement with the experiments of Niemela and Donnelly. The crossover between the high-frequency ("Stokes layer") regime and the low-frequency regime studied previously is analyzed.

2136 **Nonlinear stability analysis of inviscid flows in three dimensions: Incompressible fluids and barotropic fluids.** Abarbanel, H.D.I.; Holm, D.D. (Marine Physical Laboratory, A-013, Scripps Institution of Oceanography and Institute for Nonlinear Science, R-002, University of California, San Diego, La Jolla, California 92093). *Physics of Fluids;* **30**: No. 11, 3369-3382(Nov 1987).

Using the energy-conserved quantity method developed by Arnol'd [Doki. Mat. Nauk 162, 773 (1965); Am. Math. Soc. Trans. 19, 267 (1969)] a study was made of the nonlinear stability of two inviscid fluid flows in three dimensions: (1) flow of a homogeneous fluid and (2) flow of a fluid whose energy density depends on the mass density alone (a so-called barotropic fluid). In order to implement the Arnol'd technique one must identify the quantities conserved by the flow in addition to the total energy. In the case of the two flows considered, the conserved quantities cannot be expressed in terms of the usual Eulerian variables: fluid velocity and mass density: alone. Instead the introduction of the Lagrangian labels of the fluid elements is required. A complete description of these conserved quantities, in both Eulerian and Lagrangian specifications of the fluid, is provided. The phase space of the flow is the entire Hamiltonian phase space expressed in either canonical or noncanonical variables. The nature of the flows to which the Arnol'd method is applicable is discussed in some depth. It was discovered that only time independent Eulerian flows can be discussed by the method; this result is given a general Hamiltonian context. The allowed Eulerian equilibria are displayed in detail. Finally, having the formal structure of these flows well in hand, it is shown that they are not, in three dimensions, formally stable. This results from a particle vortex stretching mechanism which is identified. The nature of the indicated instability is not revealed by this work, but may well be a slowly evolving Arnol'd diffusion kind of breakdown of the equilibrium.

2137 **Application of Kraichnan's decimated-amplitude scheme to the Betchov model of turbulence.** Williams, T.; Tracy, E.R.; Vahala, G. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). *Physical Review Letters;* **59**: No. 17, 1922-1925(26 Oct 1987).

The decimated-amplitude scheme (DAS) devised by Kraichnan is applied to a random-coupling model of turbulence originally introduced by Betchov to test the direct-interaction approximation (DIA). Using a system of 32 variables, forced stochastically under appropriate statistical constraints, it is shown that the DAS can accurately represent the autocorrelation function of a full Betchov system of 96 variables. A comparison is also made between the DAS and the DIA.

2138 **Initial stages of pattern formation in Rayleigh-Benard convection.** Meyer, C.W.; Ahlers, G.; Cannell, D.S. (Department of Physics, University of California, Santa Barbara, California 93106). *Physical Review Letters;* **59**: No. 14, 1577-1580(5 Oct 1987).

Flow-visualization studies and heat-flux measurements during the early evolution of convection in a cylindrical container of aspect ratio 10 (radius/height) are reported. The heat current was ramped linearly, or modulated time periodically, from below to above the onset value. A novel sidewall design allowed pattern formation to occur independently of container geometry. In the earliest stages, the patterns were composed of irregularly arranged cells and varied randomly between experimental runs. The results demonstrate the importance of stochastic effects during the pattern evolution.

2139 **Numerical laboratory.** Winkler, K.A.; Chalmers, J.W.; Hodson, S.W.; Woodward, P.R.; Zabusky, N.J. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Physics Today;* **40**: No. 10, 28-37(Oct 1987). Contract FG02-87ER25035.

One can simulate and visualize the complex evolution of fluid flow by doing 'computer experiments,' which have emerged as a third method for investigating nature, complementing traditional experimental and theoretical work.

2140 **Direct measurements of thermal vacancies in bcc ^{4}He.** Granfors, P.R.; Fraass, B.A.; Simmons, R.O. (Univ. of Illinois, Urbana-Champaign). *Journal of Low Temperature Physics;* **67**: No. 5-6, 353-375(Jun 1987). Contract AC02-76ER01198.

X-ray lattice parameters of bcc ^{4}He crystals in contact with superfluid ^{4}He were measured with 300 ppm accuracy in the temperature range 1.494-1.711 K, corresponding to solid molar volumes between 20.88 and 21.09 cm^3. Thermal vacancy concentrations in the solid at melting were estimated from a comparison of these lattice parameters with bulk solid molar volumes from the literature. Independently, temperature-dependent x-ray lattice parameter measurements on a bcc sample, held at constant macroscopic volume from 1.700 to 1.735 K, were referenced to the same solid sample (at 20.90 cm^3) in the hcp phase near 0.8 K, where thermal vacancy content is small. The value of the free energy of formation for vacancies in bcc ^{4}He obtained from these measurements is f = 9 +/- 1 K. The relationship between this value and indirect inferences about vacancy formation from ion mobility and NMR experiments

is discussed. Comparisons are made between vacancy properties in bcc ^{4}He and in the more extensively studied bcc phase of ^{3}He. There are many parallels between the two systems. But a puzzling apparent difference between the vacancy relaxation energies in the two solids is pointed out.

2141 **Hydrogen dissociation below 1 K.** Helffrich, J.; Maley, M.; Krusius, M.; Wheatley, J.C. (Los Alamos National Lab., NM). *Journal of Low Temperature Physics;* 66: No. 5-6, 277-304(Mar 1987).

The authors report on an investigation of hydrogen dissociation at dilution refrigerator temperatures. The objective of this study is to develop a low-temperature hydrogen atom source for experiments on spin-polarized atomic hydrogen. They find that, in a discharge tube coated with a solid H_2 layer and a superfluid He film, hydrogen dissociation is mediated by a glow discharge supported by He vapor. The He discharge provides the energetic particles needed for removing H atoms from the solid H_2 coating. In order to strike a He discharge, the He vapor pressure has to correspond to a wall temperature of 0.60-0.75 K. The best results are obtained close to the low-temperature threshold for ignition, or at even lower temperatures if the rf discharge pulse is preceded by a heat pulse adjusted to flash-evaporate the required initial He density. Hydrogen atom yields of 10^{18} H/discharge pulse are typical, and scale with the pulsed rf energy as long as the discharge volume is not overheated and remains in good thermal contact with its cooling jacket. In these conditions the H flux from the dissociator is proportional to the average rf power with a dissociation efficiency of ~ 3%. With a dilution refrigerator circulation of 0.3 mmole/sec of ^{3}He, H fluxes of 5 x 10^{18} H/sec are obtained in steady-state discharge conditions.

2142 **Experimental cosmology: Strings in superfluid helium.** Zurek, W.H. (Los Alamos National Lab.). pp 479 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The superfluid phase of helium 4 can be described by effective field theory with the potential V(psi) = α(T) vertical bar psi vertical bar /sup 2/ + (B/2)vertical bar psi vertical bar /sup 4/. The complex field psi = vertical bar psi vertical bar exp (iΘ) is the wave function of the Bose condensate. Below the superfluid transition temperature, Tλ, the coefficient α(T) is negative and V(PSI) assumes the "sombrero" shape. Ground state at T<T has broken U(1) symmetry and a definite Θ. This allows the existence of global U(1) strings, which in the superfluid are known as "vertex lines." The author proposes an experiment in which the superfluid phase transition is achieved by a rapid drop of pressure. If the local choices of phase Θ occur independently in volumes separated by more than the correlation length ν -- as assumed in the cosmological scenarios for string production -- the resulting superfluid should trap an abundance of vortex lines. Experiments of this kind can be used not only as a test of cosmological scenarios for production of topological defects, but may be also employed to address other issues (e.g. the nature of fluctuations, causality and the existence of long-range correlations which are of key importance in the currently discussed cosmological models.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 2334, 2340

2143 **(INIS-SU—414) JINR rapid communications. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1986. 54p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780009/JAW.

Separate abstracts were prepared for individual papers in this collection. (LEW)

2144 **(INIS-SU—422) JINR rapid communications. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1986. 52p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780010/JAW.

Separate abstracts were prepared for individual papers in this collection. (LEW)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 1537, 1543, 1573, 1645, 2233, 2241, 2261, 2290, 2295, 2303, 2342

2145 **(CEA-CONF—8872) Inelastic nucleon-nucleon channels.** Terrien, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Nov 1986. 14p. (In French). (CEA-DPH-N-S—2400; CONF-8611138—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752915/JAW.

From Saturne workshop; La Londe-les-Maures, France (10 Nov 1986).

This paper presents the interest of inelastic nucleon-nucleon channels, more particularly the NN -> NN π channels, pointing out the experimental aspects. Saturne possibilities are examined in this field. 43 references.

2146 **(CEA-CONF—8877) Nucleon-nucleon program at SATURNE.** Perrot, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Nov 1986. 15p. (In French). (CEA-DPH-N-S—2406; CONF-8611138—9). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752919/JAW.

From Saturne workshop; La Londe-les-Maures, France (10 Nov 1986).

The recent results of observable measurements depending on spin in pp and np scattering are presented and discussed. These results have allowed to extend the phase shift analysis into 1.3 GeV. They challenge the possibility of a resonance in the $^3F_3$ wave, but prove the possible presence of resonances in the partial waves $^3P_2$, $^1D_2$ and $^1G_4$. 15 references.

2147 **(CERN-EP—86-115) UA1 results on W and Z^0 physics.** Geer, S. (Harvard Univ., Cambridge, MA (USA); European Organization for Nuclear Research, Geneva (Switzerland)). 2 Sep 1986. 22p. (CONF-860701—89). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900056/JAW.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Current results from the analysis of the UA 1 W and Z^0 event samples are used to test the standard SU(2) circle times U(1) electroweak model. Limits are placed on the number of light neutrino types in the Universe, and on the existence of heavy W- and Z^0-like objects. 17 refs.

2148 **(CERN-EP—87-07) Heavy-flavour production at the CERN proton-antiproton collider.** Negra, M.D. (European Organization for Nuclear Research, Geneva (Switzerland)). 14 Jan 1987. 33p. (CONF-8606286—4). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900043/JAW.

From 6. international conference on proton-antiproton physics; Aachen, F.R. Germany (30 Jun 1986).

Results from the analysis of the full muon data sample of 692 nb^{-1} in the UA1 experiment are presented. Semileptonic decays of beauty particles are the dominant source of high-rho/sub tau/ muons inside jets. In the isolated dimuon data, clear signals for Y $\rightarrow \mu^+\mu^-$ and J/psi $\rightarrow \mu^+\mu^-$ are also observed above the continuum from the Drell-Yan mechanism. Non-isolated dimuons are shown to come predominantly from pairs of beauty hadrons produced through the QCD flavor creation process q anti q, gg $\rightarrow$ b anti b. The yield of like-sign dimuons is observed to be in excess of that expected from second-generation decays p anti p $\rightarrow$ b anti b, b $\rightarrow \mu^-$, anti b $\rightarrow$ anti c $\rightarrow \mu^-$. A natural explanation for this excess is the existence of a significant amount of B^0-anti B^0 transitions. The fraction of 'wrong sign' b-quark decays averaged over all b-hadron states is chi = 0.121 +- 0.047. Combined with e^+e^- limits, our

measurement of chi implies that oscillations occur mainly between B/sub s/°-anti B/sub s/° states as favored theoretically. The analysis of isolated lepton + jet events and their top signature is in progress. 29 refs.

2140 **(CERN-EP—87-19) Antinucleon annihilations at low energies at LEAR.** Gastaldi, U. (European Organization for Nuclear Research, Geneva (Switzerland)). 2 Feb 1987. 13p. (CONF-8610185—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900044/JAW.

From Autumn school on few-body methods; Lisbon, Portugal (13 Oct 1986).

This report is limited to a skeletal summary of the topics covered in the lecture. The arguments discussed were: physics interest of N anti N annihilations; S and P-wave p anti p annihilation at rest: new experimental techniques established with the ASTERIX detector at LEAR and physics prospects; anti p annihilation in nuclei: experimental findings of the Streamer chamber detector at LEAR and physics prospects; brief presentation of LEAR and summary of the physics programme planned starting from the end of 1987 when the antiproton collector (ACOL) will come into operation. 24 refs., 4 figs., 2 tabs.

2150 **(CERN-EP—87-86) Beauty physics at UA1.** Summers, D.J. (Wisconsin Univ., Madison (USA); European Organization for Nuclear Research, Geneva (Switzerland)). 7 May 1987. 12p. (CONF-870121—11). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900039/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society; Salt Lake City, UT, USA (14 Jan 1987).

The observation of pairs of high p/sub t/ muons, each accompanied by a jet, provides evidence for beauty particle production at the CERN anti pp collider. By measuring the transverse momentum of each muon relative to the jet which accompanies it, we find that 90% of the m/sub $\mu\mu$/ > 6 GeV/c^2 events where each muon has p/sub t/ > 3 GeV/c are due to the semi-leptonic decay of beauty particles, after background subtraction. We also observe a clear signal for $\Upsilon \rightarrow \mu^+\mu^-$ (hidden beauty) when the muons are relatively isolated from jet activity, and observe a large cross section for J/psi $\rightarrow \mu^+\mu^-$ production; both well above the continuum of Drell-Yan muon pairs. The beauty flavor creation (gg or anti qq $\rightarrow$ b anti b) cross section needed to explain the dimuon rate is σ(anti pp $\rightarrow$ b anti bX) = 1.1 +- 0.1 +- 0.4 μb, where p/sub t// sup b/ > 5 GeV/c and absolute value of eta < 2.0 for both beauty quarks; in good agreement with QCD predictions. However, the observed like-sign dimuon rate is larger than that expected from events with one first and one second generation decay (e.g. anti pp $\rightarrow$ b anti bX; b $\rightarrow \mu^-$, anti b $\rightarrow$ anti c $\rightarrow \mu^-$). The predicted ratio of like-sign to unlike-sign dimuons is 0.26 +- 0.03. Experimentally, we measure 0.42 +- 0.07 +- 0.03. A significant number of $B^0 \rightleftharpoons$ anti B^0 transitions would explain the observed excess of like-sign events. The fraction of all beauty particles that decay directly into a muon with the opposite charge from that expected with no mixing is thus deduced to be 0.121 +- 0.047. 20 refs.

2151 **(CERN-EP—87-115) Results on electroweak interactions from the CERN p anti p Collider.** Parker, M.A. (European Organization for Nuclear Research, Geneva (Switzerland)). 2 Jul 1987. 18p. (CONF-870334—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900047/JAW.

From Workshop on results and perspectives in particle physics; La Thuile, Italy (1 Mar 1987).

Results from the UA1 and UA2 Collaborations on the Standard Model of electroweak interactions are reviewed. The parameters of the Standard Model are extracted and compared with theoretical calculations. All the data are found to be in good agreement both amongst themselves and with expectation. Limits on the number of light neutrino species are discussed. 13 refs., 11 figs., 8 tabs.

2152 **(CERN-EP—87-119) Physics at the CERN p anti p collider: Some recent results and prospects.** Froidevaux, D. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire; European Organization for Nuclear Research, Geneva (Switzerland)). 8 Jul 1987. 34p. (CONF-870121—12). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900046/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society; Salt Lake City, UT, USA (14 Jan 1987).

This review covers some of the most recent results from the UA1 and UA2 experiments at the CERN p anti p Collider. We then discuss the status of the upgrading programs of both experiments and some of the physics goals which are hoped to be reached once the upgraded Collider [with the Antiproton Collector (ACOL)] has delivered about 10 pb^{-1}. 47 refs., 17 figs., 4 tabs.

2153 **(CERN-EP—87-127) Experimental comments on the suppression of strangeness and diquarks in parton fragmentation.** Geist, W.M. (Lawrence Berkeley Lab., CA (USA); European Organization for Nuclear Research, Geneva (Switzerland)). 22 Jul 1987. Contract AC03-76SF00098. 9p. (CONF-870339—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000283/JAW.

From Moriond meeting on hadrons, quarks and gluons; Les Arcs, France (15 Mar 1987).

Data on production of kaons and antiprotons from e^+e^- annihilation, deep-inelastic lepton-hadron, and hadron-hadron scattering are compared on a qualitative level. Evidence for unfamiliar trends is found. 18 refs.

2154 **(CERN-EP—87-138) Limits on the masses of supersymmetric particles from UA1 events with large missing transverse energy.** Seez, C.J. (Imperial Coll. of Science and Technology, London (UK); European Organization for Nuclear Research, Geneva (Switzerland)). 4 Aug 1987. 9p. (CONF-8705198—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900036/JAW.

From 2. topical seminar on heavy flavour physics; San Miniato, Italy (25 May 1987).

A sample of events with large missing transverse energy, taken in the UA1 detector and representing an integrated luminosity of 715 nb^{-1}, is used to set limits on the masses of squarks and gluinos. We find m/sub anti q/ > 45 GeV/c^2 at 90% CL, independent of the gluino mass, and m/sub anti g/ > 53 GeV/c^2 independent of squark mass, provided that the gluino is not long-lived. If m/sub anti q/ = m/sub anti g/ = m we find m > 75 GeV/c^2.

2155 **(CONF-870283—13) Search for neutrino oscillations at the AGS with the narrow band beam.** Chi, C.; Kondakis, N.; Lee, W.; O'Brien, E.; O'Halloran, T.; Reardon, K.; Salman, S.; Blumenfeld, B.; Chichura, L.; Chien, C.Y. (Columbia Univ., New York (USA). Dept. of Physics; Illinois Univ., Urbana (USA). Dept. of Physics; Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Physics and Astronomy). 1987. Contract AC02-76ER01195. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013463/JAW.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

We have taken neutrino data with the Narrow Band Beam (NBB) at Brookhaven National Laboratory (BNL) in the summer and fall of 1985. We are in the process of completing the analysis of the NBB data. In this paper we present preliminary results of this analysis. We observe an anomalous appearance of electron neutrinos above the expected background. 3 refs., 16 figs., 3 tabs.

2156 (CONF-8605182—, pp 1-11) **Phenomenology of e^+e^- events at GSI: axions and other goodies.** Krauss, L.M. (Yale Univ., New Haven, CT). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW. Contract AC02-76ER03075.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

The author reviews the experimental results of the EPOS collaboration at GSI indicating the presence of correlated e^+e^-

pairs with kinetic energy at about 370 KeV per particle, arising from collisions of different heavy ion systems at about 5.9 MeV per nucleon on stationary targets. He then discusses constraints on nuclear production mechanisms, new results on axion theory and experiment, and finally, experimental constraints on any new elementary scalar particle at 1.8 MeV which couples to electrons.

2157 (CONF-8605182—, pp 43-61) **New charm results using high precision vertex detectors.** dos Anjos, J.C.C.; Appel, J.A.; Bracker, S.B.; Browder, T.E.; Cremaldi, l.M.; Elliott, J.R.; Escobar, C.E.; Estabrooks, P.; Gibney, M.C.; Hartner, G.F.; Karchin, P.E. (Univ. of California, Santa Barbara). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

The first results from the charm photoproduction experiment E691 at the Fermilab are presented. Using a silicon microstrip vertex detector (SMD), a very large sample of clean charm decays has been recorded. The use of SMD's for isolating clean signals and for measuring lifetimes is discussed. From the 15% of the data so far analyzed, the lifetimes of the D^0 and D^+ mesons are found to be .44 +/- .02 +/- .02 10^{-12} sec and 1.09/sub -.09//sup +.08/ +/- .06 10^{-12} sec, respectively, and the lifetime ratio is 2.5 +/- .2 +/- .1. The F^+ meson is observed in the phi π^+ mode with the lifetime found to be .40/sub -.08//sup +.12/ +/- .06 10^{-12} seconds. The F^+ has a cross section times branching ratio which is 2.4 /sub -0.9// sup +1.3/ times that for $D^+ \rightarrow$ phi π^+. Charm meson lifetimes are reviewed and future prospects for fixed target charm and for SMD detectors are discussed.

2158 (CONF-8605182—, pp 63-81) **Review of charm quark physics.** Brown, J.S. (Univ. of Illinois, Urbana). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

A review of recent developments in the field of charm physics is presented. Measurements of the mass of the F^+ and F^{*+} provide tests of their understanding of the charmed meson spectroscopy. The recent results on the lifetime measurements of the D and F mesons are reviewed. The latest results on the production cross-sections and inclusive and exclusive decays of the D mesons are discussed. Finally, the latest results on J/psi exclusive decays and their implications are reviewed with emphasis on the status of the zeta(2240) and the glueball candidate theta(1720).

2159 (CONF-8605182—, pp 83-107) **Production of hadrons and leptons at high P/sub t/ and pairs at high mass.** Kaplan, D.M. (Florida State Univ., Tallahassee). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

Hadron production at high transverse momentum was studied in 400 GeV proton reactions on beryllium, copper, tungsten, lithium hydride and lithium deuteride in beam dump experiments at Fermilab. The experimental setup is described. Differential cross sections as a function of transverse momentum and angle are presented and compared to Monte Carlo calculations. Data on particle ratios are shown. Hadron and lepton production at 800 GeV on beryllium, copper and lead are also summarized. A search for axions is discussed.

2160 (CONF-8605182—, pp 109-129) **b-Physics.** Wilson, R. (Harvard Univ., Cambridge, MA). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

Experimental results on b quark physics from CESR and DORIS are reviewed. Results for the B meson are emphasized and data is presented for its mass, leptonic decay and weak hadronic decay modes. Branching ratios, decay spectra and multiplicity are discussed.

2161 (CONF-8605182—, pp 131-148) **Heavy quark production and missing energy studies at the CERN p anti p collider UA1 collaboration.** Kernan, A. (Univ. of California, Riverside). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

The cross section for strong b anti b production is inferred from the flux of high P/sub T/ muons observed in p anti p collisions at the CERN collider. Like-sign dimuon events give evidence for B^0/sub s/-anti B^0/sub s/ mixing. Events with jets and missing transverse energy are due mainly to $W \rightarrow$ tau nu with hadronic decay of tau. These results come from 120 nb^{-1} of data at $\sqrt{s}$ of 546 GeV and 600 nb^{-1} at $\sqrt{s}$ of 630 GeV.

2162 (CONF-8605182—, pp 149-164) **Collider physics.** Barger, V. (Univ. of Wisconsin, Madison). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW. Contract AC02-76ER00881.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

QCD shower simulations of W production are compared with UA1 data; two recently observed $W \rightarrow$ ell nu events with p/sub T/(W) > 50 GeV and dijets are shown to be marginably compatible with expectations. The status of the search for a charged fourth generation heavy lepton in p anti p collisions is discussed. The implications of CERN dimuon events for B^0 - anti B^0 mixing are considered. Trimuon events may aid in future p anti p collider identification of t-quark contributions. Superstrings offer interesting new possibilities for phenomenology, such as an extra neutral gauge boson (Z') and exotic fermions belonging to 27 representations of E_6. Prospects for finding these particles are evaluated.

2163 (CONF-8605182—, pp 253-272) **Experimental bounds on $\beta\beta$-decay, cold dark matter and solar axions with an ultralow background Ge detector.** Avignone, F.T. III; Ahlen, S.P.; Brodzinski, R.L.; Dimopolous, S.; Drukier, A.K.; Gelmini, G.; Lynn, B.W.; Miley, H.S.; Reeves, J.H.; Spergel, D.N.; Starkman, G.D. (Univ. of South Carolina, Columbia). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

The PNL/USC ultralow background prototype Ge detector in the Homestake goldmine is being applied to searches for O nu $\beta\beta$-decay, dark matter candidates and solar axions. An upper bound of 2.2 eV has been placed on the Majorana mass of the electron neutrino. The low energy data exclude particles with spin independent Z^0 exchange interactions having masses between 20 GeV and 5 TeV, as significant contributors to the cold dark matter of the halo of their galaxy. The existence of stable Dirac neutrinos more massive than 20 GeV is also excluded except for a narrow region around the Z^0 resonance. Finally, Dine-Fischler-Srednicki (DFS) axion models with F/2x/sub e/' $\leq$ 0.5 x10^7 GeV are ruled out by the maximum count rate attributable to solar axions.

2164 (CONF-8605182—, pp 299-328) **Recent progress in particle physics.** de Rujula, A. (CERN, Geneva, Switzerland). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

The author discusses various subjects of current interest, among them the coincident electron and positron lines observed in heavy ion reactions, masses and mixings of terrestrial and solar neutrinos, progress in the grand unified front and in lattice gauge theories, superstrings, and the dark mass and big voids of the Universe.

2165 (DOE/ER/02504—457) **High energy accelerator and colliding beam user group: Progress report, March 1, 1987-February 29, 1988.** (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Sep 1987. Contract AC05-76ER02504. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88001472/JAW.

Progress is reported on the OPAL experiment at LEP, including construction and assembly of the hadron calorimeter and development of OPAL software. Progress on the JADE experiment, which examines e^+e^- interactions at PETRA, and of the PLUTO collaboration are also discussed. Experiments at Fermilab are reported, including deep inelastic muon scattering at TeV II, the D0 experiment at TeV I, and hadron jet physics. Neutrino-electron elastic scattering and a search for point-sources of ultra-high energy cosmic rays are reported. Other activities discussed include polarization in electron storage rings, participation in studies for the SSC and LEP 200, neutron-antineutron oscillations, and the work of the electronics support group. High energy physics computer experience is also discussed. 158 refs. (LEW)

2166 **(DOE/ER/40318—1) Σi and Ξ⁻ radiative decay studies: Progress report for the period 1 August 1986-30 September 1987.** McCliment, E.R.; Newsom, C.R. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1987. Contract AC02-87ER40318. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000801/JAW.

The period covered by this progress report coincides with the hardware development phase of Fermilab experiment E761, which will run in the fall of 1988 and winter of 1989. Our contribution to the hardware is a silicon strip detector system for precision measurement of the hyperon beam momentum. We started this project by building a prototype station, MARK II, and testing it extensively, first at Iowa using a radioactive source, and then at LAMPF using a test beam. The results obtained were used to design the final version of the detector station, MARK III. Three MARK-III stations, the number required for the experiment, have been built and transported to Fermilab. Two have been installed in a test beam in P-Center, and the third is awaiting installation. Data taking has just gotten underway to study noise, efficiency, alignment procedures, and tracking. We have also been engaged in analyzing three-track triggers from Fermilab experiment E715 with the aim of measuring the cascade minus magnetic moment and production polarization. To date, we have analyzed 60% of the data and obtained therefrom 100,000 fully reconstructed nonleptonic cascade decays. Of these 40,000 have the right polarization to use for a magnetic moment determination. The rest are useful for studying production polarization and systematics.

2167 **(DOE/ER/40325—1) Experimental studies of elementary particle interactions at high energies: Technical progress report.** (Rockefeller Univ., New York (USA)). 21 Sep 1987. Contract AC02-87ER40325. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000804/JAW.

This paper discusses progress of experiments at CERN and Fermilab. At CERN, data accumulation and analysis is discussed for the UA-6 experiment, which involves proton-antiproton collisions. At Fermilab, the testing of a collider detector for the Tevatron is discussed. (LSP)

2168 **(FNAL/C—87/150-E) Measurement of same-sign dimuon production in high-energy neutrino interactions.** Merritt, F.S.; Oreglia, M.; Schellman, H.; Schumm, B.A.; Bachmann, K.T.; Bernstein, R.H.; Borcherding, F.; Bodek, A.; Budd, H.S.; Sakumoto, W.K. (Chicago Univ., IL (USA); Columbia Univ., New York (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Rochester Univ., NY (USA)). Sep 1987. Contract AC02-76CH03000. 16p. (CONF-8709152—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000735/JAW.

From 18. international symposium on multiparticle dynamics; Tashkent, USSR (8 Sep 1987).

We present rates for same-sign dimuon production in neutrino-iron interactions with energies of 30 to 600 GeV. We find 101 neutrino and 15 anti-neutrino induced same-sign dimuons with muon momenta above 9 GeV/c. A detailed calculation indicates that the overall level and kinematic distributions of conventional backgrounds are consistent with the data. There is no convincing indication of new physical processes. 16 refs., 11 figs., 1 tab.

2169 **(INIS-SU—414, pp 34-41) Observation of narrow diproton resonances with 1966 and 1989 MeV/c/sup 2/ masses.** Abdinov, O.B.; Bajramov, A.A.; Mailov, A.A.; Budagov, Yu.A.; Lomakin, Yu.F.; Flyagin, V.B.; Kharzheev, Yu.N.; Dvornik, Yu.N. (AN Azerbajdzhanskoj SSR, Baku. Inst. Fiziki; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Nuclear Problems; Gomel'skij Gosudarstvennyj Univ., Byelorussian SSR). 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780009/JAW. (JINR-N—15-86).

In JINR rapid communications. Collection.

Narrow (less than 10 MeV/c/sup 2/) structures (4-5 standard deviations) have been observed in two proton effective mass spectra. These could be considered as diproton resonances. The data have been obtained by processing film film information from one-meter bubble chamber of JINR with propane and propane-freon filling which has been irradiated by 5 GeV/c π/sup -/- mesons on the JINR sunchrophasotron. The data on the cross sections of resonance production on nuclei and proton angular distributions in s.c.i. of resonances are presented. 19 refs.; 5 figs.; 2 tabs.

2170 **(LA-UR—87-3175) Neutrino-electron scattering and the choice between different MSW solutions of the solar neutrino problem.** Rosen, S.P.; Gelb, J.M. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-8708147—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000490/JAW.

From International symposium on underground physics; Baksan, USSR (17 Aug 1987).

We consider the scattering of solar neutrinos by electrons as a means for distinguishing between MSW solutions of the solar neutrino problem. In terms of the ratio R between the observed cross-section and that for pure electron-type neutrinos, we find that some correlation between the value R and the appropriate solution. 9 refs., 3 figs.

2171 **(LAL—86-31) Searches for new particles.** Davier, M. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Oct 1986. 31p. (CONF-860701—86). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752683/JAW.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

New experimental results on particle searches are reviewed. Two experimental techniques give powerful limits: single photon events in e/sup +/e/sup -/ annihilation and missing transverse momentum in antipp collisions. The standard model phenomenology still awaits the discovery of the top quark and of the Higgs boson; no fourth generation appears in sight and looks in fact unlikely. Axion searches are negative, despite a renewed interest due to anomalous positron production in heavy ion collisions which turns out not to be explainable within particle physics only. Supersymmetry remains an elegant theory without contact with experiment. 107 refs.

2172 **(LAL—86-33) DM2 results on hadronic and radiative J/PSI decays.** Jean-Marie, B. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Oct 1986. 9p. (CONF-860701—87). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752684/JAW.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

A preliminary study of the J/PSI -> γrho/sup 0/rho/sup 0/ decay is presented. The existence of the decay J/PSI -> γD(1285) is established by the observation of two decay modes D -> 4π/sup +-/ and D -> etaπ/sup +/ π/sup -/. The channel J/PSI -> PHID(1285) is evidenced in the same way. A systematic comparison of KantiK and $\pi\pi$ production associated to γ, ω and PHI leads to results concerning K/sup 0//sub S/K/sup 0//sub S/, PHI, f, S* and $\pi\pi$ states. SU(3) and electromagnetic violations are tested by measuring allowed and forbidden baryonic decays. Finally a measurement of J/PSI -> K/sup 0//sub S/K/sup 0//sub L/ is presented. 17 figs., 16 refs.

2173 **(LBL—23549) Charmonium spectroscopy, 1987.** Cahn, R.N. (Lawrence Berkeley Lab., CA (USA)). 30 Jul 1987. Contract AC03-76SF00098. 13p. (CONF-8705199—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000205/JAW.

From Mark III pow-wow conference; Hillsborough, CA, USA (9 May 1987).

The state of charmonium spectroscopy is reviewed. All analyses proceed from a spin-dependent, non-relativistic Schroedinger equation. Many of the possible branching ratios for charm like states are investigated. 17 refs.

2174 **(LBL—23694) The physics of new Z' bosons.** del Aguila, F.; Quiros, M.; Zwirner, F. (Lawrence Berkeley Lab., CA (USA); Barcelona Univ. (Spain). Dept. de Fisica Teorica; Consejo Superior de Investigaciones Cientificas, Madrid (Spain). Ist. Estructura de la Materia). Jun 1987. Contract AC03-76SF00098. 11p. (CONF-870180—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014686/JAW.

From Workshop on physics at future accelerators; La Thuile, Italy (7 Jan 1987).

We present a convenient parametrization for the couplings of a possible new neutral gauge boson (Z') with mass within the TeV region, and we exemplify it with three superstring-inspired models. We describe some general aspects of the Z' physics: mixing with the standard model Z^0 and its effects, present experimental limits, expected width and branching ratios, perspectives for Z' detection at future hadronic colliders. 11 refs.

2175 **(PITHA—86/12) B-production and the evidence for B^0-anti B^0 mixing at the CERN p anti p collider.** Eggert, K. (Technische Hochschule Aachen (Germany, F.R.). 3. Physikalisches Inst.). Aug 1986. 20p. (CONF-8603118—9). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900060/JAW.

From 21. Recontre de Moriond: perspectives in electroweak interactions and unified theories; Les Arcs, France (9 Mar 1986).

Muon pair production has been observed at the CERN p anti p-collider at c.m. energies of 540 and 630 GeV. The events are interpreted in terms of the Drell-Yan mechanism, J/psi and Y-decays, and of semileptonic decays of heavy quark pairs. The inclusive b-quark production cross-section is large (several μb). The properties of the dimuon events, which are dominated by b anti b production, are in excellent agreement with QCD calculations, except for the large value of R, the ratio of like sign to unlike sign events. The most likely explanation of the observed R = 0.46 +- 0.07 +- 0.03 is the existence of B^0-anti B^0 oscillations. This is not at variance with e^+e^- data, provided the oscillations occur between b anti s and anti b s states.

2176 **(SLAC-PUB—4407) Charmless B decays to baryons.** Gronau, M. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1987. Contract AC03-76SF00515. 5p. (CONF-8709147—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000709/JAW.

From International symposium on the production and decay of heavy flavors; Stanford, CA, USA (1 Sep 1987).

We attempt an estimate of vertical bar V/sub ub//V/sub cb/vertical bar from the recent ARGUS observation of $B^{+-} \rightarrow p$ anti $p\pi^{+-}$ and $B^0 \rightarrow p$ anti $p\pi^+\pi^-$ by studying general processes of the type $B \rightarrow N$ anti $N + n\pi$ ($n \geq 0$). The main ingredients of the analysis are the pion multiplicity distribution and a few models for the isospin structure of the final state. It is concluded quite generally that vertical bar V/sub ub//V/sub cb/vertical bar = 0.25 +- 0.10 and vertical bar V/sub ub//V/sub cb/vertical bar $\geq$ 0.08. The ratio may become lower only in the event that both the relevant experimental and theoretical quantities obtain the extreme values considered in our study. We also discuss briefly a possible realization of a $\Delta I = 1/2$ rule in these processes.

2177 **(SLAC-PUB—4417) Has the charm deficit really vanished?.** Schindler, R.H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1987. Contract AC03-76SF00515. 7p. (CONF-870632—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000703/JAW.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

Many experiments have observed charmed particles inclusively in e^+e^- annihilation, hadro-, photo-, and neutrino- production, and recently in the direct cascade process from B meson decay. The scale of these measurements is set largely by the branching ratios $B(D^0 \rightarrow K^-\pi^+)$ and $B(D^+ \rightarrow K^-\pi^+\pi^+)$. These branching fractions have been measured by attributing the enhancement in the total hadronic cross section at the psi(3770) resonance to D anti D production, and normalizing the rates for $K^-\pi^+$ and $K^-\pi^+\pi^+$ accordingly. These height measurements however exhibit a wide variance. Two years ago a new technique for measuring branching fractions was introduced by the Mark III, which largely avoided the cross section normalization. The result, however, yielded significantly larger values for all branching ratios while leaving their relative values unchanged. In turn, it created a problem for subsequent high statistics inclusive measurements of charm (in particular the continuum e^+e^- production rate and B cascade decay rates) where an ~50% "deficit" of charm was claimed to exist by CLEO. With the rescaling downward by 24% (21%) of the Mark III D^0 (D^+) values, the so-called "charm deficit" is again addressed in this review. Also introduced here are new measurements from ARGUS and HRS which also directly address the issue of charm normalization with statistics comparable to other measurements. Finally, an attempt is made to understand the whole body of psi(3770) resonance data. 13 refs.

2178 **Consequences of the large real-to-imaginary ratio at $\sqrt{s}$ = 546 GeV.** Leader, E. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **59**: No. 14, 1525-1526(5 Oct 1987). Contract AC02-76CH00016.

The remarkably large value of rho = Ref/Imf at $\sqrt{s}$ = 546 GeV found recently in an experiment at the CERN Spp-barS collider is shown to have dramatic consequences.

2179 **Production of the charmed strange baryon γ/sub c/$^+$ by neutrons.** Coteus, P.; Binkley, M.; Bossi, F.; Butler, J.; Cumalat, J.P.; DiCorato, M.; Diesburg, M.; Enagonio, J.; Filaseta, J.; Frabetti, a.P.L.; and others. (University of Colorado, Boulder, Colorado 80303,). *Physical Review Letters;* **59**: No. 14, 1530-1533(5 Oct 1987).

We report on the observation of a narrow resonance at a mass of 2459 MeV/c^2 in the final states $\Lambda K^-\pi^+\pi^+$ and $\Sigma^0K^-\pi^+\pi^+$. The mass, width, lifetime, and decay modes support the interpretation of a hadronically produced charmed strange baryon, the γ/sub c/$^+$. We present our measurements of the lifetime, cross section, and relative branching fractions, and the A, x/sub f/, and p/sub t/ dependence of the state.

2180 **Rho and omega production in p$^+$p interactions at 15.7 GeV/c.** Ferguson, M.; Glanzman, T.; Goshaw, A.T.; Lucas, P.; Morgan, N.; Robertson, W.; Walker, W.D.; Barlow, P.M.; Clark, R.K.; Diamond, R.N. (Duke University, Durham, North Carolina 27706). *Physical Review [Section] D: Particles and Fields;* **36**: No. 7, 1961-1970(1 Oct 1987).

We report the results of a study of rho and ω production in π^+p interactions at 15.7 GeV/c. The SLAC hybrid bubble-chamber facility was used to study reactions in which neutral particles are produced. Three tantalum plates inside the 40-in. bubble chamber and a large array of lead glass downstream of the chamber provided photon detection over a large solid angle. Final states with two neutral particles have been isolated with kinematic fits in which neutral pions were reconstructed in the plates and lead glass. Data from an earlier untriggered π^+p bubble-chamber experiment at 15 GeV/c were used to obtain samples of events in channels which did not trigger the hybrid system. Cross sections for rho and ω production are given for several exclusive final states. Relative rho and ω production rates are studied. The ratio of nondiffractive ω to rho^0 production is measured to be ω/rho^0 = 0.44 +- 0.07. We estimate the inclusive ω cross section to be 1.9 +- 0.3 mb. The results are compared to the Lund model of low-p/sub T/ hadronic reactions.

2181 **New results on charmed D, F/sup +-/ and F/sup */ production and decay from the mark III.** Schindler, R.H. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 745-751 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515;AC02-76ER01195.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Results on charmed meson production and decay are presented from the Mark III at SPEAR FF-bar* associated production is observed allowing a direct measurement of the F*mass. A search for the decay D/sup +/-→μ/sup +/ν/sub μ/ in the recoil of hadronically tagged D/sup +-/ decays provides a stringent limit on the pseudoscalar decay constant f/sub D/. New results on D/sup 0/D-bar/sup 0/ mixing from semileptonic D/sup 0/ decays and evidence for a nonresonant component in D/sub e4/ decays are also presented.

2182 **Limits to ν/sub μ/, ν/sub e/ → ν/sub tau/ neutrino oscillations and to ν/sub μ/, ν/sub e/ → tau/sup -/ direct coupling.** Gauthier, A. (Ohio State Univ., Physics Dept., Columbus, OH 43210). pp 937-939 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors located 3886 neutrino interactions in a hybrid emulsion spectrometer installed in the Fermilab wideband neutrino beam. A search for tau/sup -/ decays produced in these interactions yielded no candidates, resulting in an upper limit of 0.002 (0.073) for direct coupling of ν/sub μ/ (ν/sub e/) to tau/sup -/. The ν/sub μ/(ν/sub e/) to ν/sub tau/ limits to mass differences and mixing angles (α) between the neutrinos are at maximum mixing, ΔM/sup 2/ < 0.9 (9.0) eV/sup 2/ and at maximum sensitivity, sin/sup 2/(2 α) < 0.004 (0.12). The direct coupling limits are also used to indicate that ν/sub tau/ is likely to be produced in tau lepton decays.

2183 **Review of elastic scattering (t = 0 parameters) and total cross sections for pp and p anti p collisions.** Block, M.M.; Cahn, R.N. (Northwestern Univ., Evanston, IL). pp 89-126 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract AC02-76ER02289;AC03-76SF00098.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Elastic scattering and total cross sections are reviewed for pp and p anti p collisions. To properly orient the reader, the manner in which measurements are made at colliding beam accelerators is explained. Predictions of the elastic scattering and total cross sections are presented for the Superconducting Super Collider (SSC).

2184 **Diffractive and rising cross sections.** Goulianos, K. (Rockefeller Univ., New York, NY). pp 127-140 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors discuss the energy dependence of the diffractive component of the proton-proton cross section and examine its contribution to the rise of the total cross section at high energies. 17 references, 9 figures.

2185 **Low P/sub T/ physics at the Sp anti pS collider.** Ward, D.R. (Univ. of Cambridge, England). pp 208-237 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Results on various aspects of low P/sub T/ minimum bias physics at the CERN Sp anti pS collider are reviewed. The bulk of the data come from the UA5 streamer chamber experiment, but results from the other UA experiments will be included where relevant. Emphasis will be placed on the energy dependence of the phenomena discussed, and possible extrapolations to SSC energies are considered. A brief account of the UA5 approach to minimum bias event simulation will be given. 42 references, 24 figures, 3 tables.

2186 **Prospects for SSC physics.** Paige, F.E. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). pp 372-392 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—). Contract AC02-76CH00016.

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

The SSC is primarily designed to explore the physics of the 1 TeV mass scale. Since new heavy particles will decay either into other new particles or into the quanta of the standard model, the main goal of SSC experiments is to identify and to measure these quanta well. Progress in simulating events and in understanding the signatures and backgrounds for standard-model physics is described.

2187 **Weak interactions at the SSC.** Chanowitz, M.S. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 183-212 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—). Contract AC03-76SF00098.

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

Prospects for the study of standard model weak interactions at the SSC are reviewed, with emphasis on the unique capability of the SSC to study the mechanism of electroweak symmetry breaking, whether the associated new quanta are at the TeV scale or higher. Symmetry breaking by the minimal Higgs mechanism and by related strong interaction dynamical variants is summarized. A set of measurements is outlined that would calibrate the proton structure functions and the backgrounds to new physics. The ability to measure the three weak gauge boson vertex is found to complement LEP II, with measurements extending to larger Q/sup 2/ at a comparable statistical level in detectable decays. B factory physics is briefly reviewed as one example of a possible broad program of high statistics studies of sub-TeV scale phenomena. The largest section of the talk is devoted to the possible manifestations of symmetry breaking in the WW and ZZ production cross sections. Some new results are presented bearing on the ability to detect high mass WW and ZZ pairs. The principal conclusion is that although nonstandard model scenarios are typically more forgiving, the capability to study symmetry breaking in the standard model (and in related strong interaction dynamical variants) requires achieving the SSC design goals of √s, £ = 40TeV,10/sup 33/cm./sup -2/sec./sup -1/.

2188 **Summary of the workshop on triggering, data acquisition and offline computing at high energy, high luminosity hadron-hadron colliders.** Cox, B. (Fermilab, Batavia, IL). pp 239-251 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—).

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

The problem of reducing the raw interaction rate of 10/sup 8/ interactions per second which is expected at a 40 TeV pp col-

lider with a 10/sup 33/ cm/sup -2/sec/sup -1/ luminosity to approximately 1 event/sec to be analyzed offline and still maintaining reasonable efficiencies for physics signals was the central focus of this workshop. The conclusion of this workshop was that such a reduction is possible. The strategies and the trigger machinery necessary to accomplish this reduction are discussed for specific physics processes such as Higgs → WW. This paper contains a brief summary of some of the more important conclusions of the workshop.

2189 **Transverse momentum signatures for heavy Higgs bosons.** Cahn, R.N.; Ellis, S.D.; Kleiss, R.; Stirling, W.J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 102-113 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—). Contract AC03-76SF00098;AC06-81ER40048.

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

Heavy Higgs bosons produced by WW fusion at the SSC will have transverse momentum of order M/sub w/. The background due to qq-bar →ZZ will produce pairs with characteristically less transverse momentum. This provides a useful discriminator. It may be possible to tag the WW fusion events in a manner analogous to that used in two photon physics.

2190 **Heavy flavor identification.** Gottschalk, T.D. (California Institute of Technology, Pasadena, CA 91125). pp 362-366 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—).

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

Techniques and difficulties of flavor tagging in high energy hadronic jets are discussed. The importance of distinguishing primary heavy flavors from G → QQ-bar cascade events is stressed. Systematic Monte Carlo studies for the immediate future are suggested.

2191 **Inner space / outer space.** Lederman, L.M. (Fermi National Accelerator Lab., Batavia, IL). pp 235-274 of Proceedings of the tenth Hawaii conference in high energy physics. Harris, F.A.; Pakvasa, S. Honolulu, HI; University of Hawaii at Manoa (1986). (CONF-8508139—).

From 10. Hawaii topical conference on particle physics; Honolulu, HI, USA (26 Aug 1985).

Inner Space and Outer Space is a discussion of current understanding of the functioning of the physical universe. The author defines inner space as the world of molecules and atoms and nuclei, protons and neutrons and eventually something called quarks and leptons and he discusses outer space as more or less everything else, but in particular, the cosmos which is often featured on TV.

2192 **Lifetime measurements at e/sup +/e/sup -/ colliders.** Goldhaber, G. (Lawrence Berkeley Lab. and Dept. of Physics, Univ. of California, Berkeley, CA). pp 49-82 of Proceedings of the tenth Hawaii conference in high energy physics. Harris, F.A.; Pakvasa, S. Honolulu, HI; University of Hawaii at Manoa (1986). (CONF-8508139—).

From 10. Hawaii topical conference on particle physics; Honolulu, HI, USA (26 Aug 1985).

In this paper the author discusses lifetime measurements with various detectors at PEP and PETRA. He emphasizes his own experiment with the SLAC-LBL Mark II detector. This was the first to introduce a vertex detector for more precise lifetime measurements. Subsequently similar devices were introduced in many of the other experiments.

2193 **Partial wave analysis of KK-barπ system in the D and E/iota regions.** Chung, S.U.; Fernow, R.; Kirk, H.; Protopopescu, S.D.; Weygand, D.P.; Boehnlein, D.; Goldman, J.H.; Hagopian, V.; Reeves, D.; Crittenden, R. (Brookhaven National Laboratory, Upton, New York 11983). *AIP (American Institute of Physics) Conference Proceedings;* **132**: No. 1, 27-36(30 Jun 1985). (CONF-8504133—). Contract AC02-76CH00016;AS05-76ER03509;AC02-84ER40125.

From International conference on hadron spectroscopy; College Park, MD, USA (20 Apr 1985).

We have performed a partial-wave analysis of the K^+K-bar/sup o/π^- system produced in the reaction $\pi^-p \to K^+$K-bar/sup o/π^-n at 8.0 GeV/c. We find that the D(1285) is a J/sup PG/ = 1^{++} state coupling predominantly to a $\delta\pi$ decay channel, while the E(1420) peak consists mostly of a J/sup PG/ = 0^{-+} wave with a substantial $\delta\pi$ decay mode. There is little evidence of a 1^{++} resonance at the E mass.

2194 **Glueball resonance and alternative explanation of the reactions πpp→phiphin.** Lindenbaum, S.J.; Longacre, R.S. (Brookhaven National Laboratory; City College of New York). *AIP (American Institute of Physics) Conference Proceedings;* **132**: No. 1, 51-67(30 Jun 1985). (CONF-8504133—). Contract AC02-76CH00016;AC02-83ER40107.

From International conference on hadron spectroscopy; College Park, MD, USA (20 Apr 1985).

The observations of three resonances (in the reaction π^-p→phiphin) which break down the OZI suppression was attributed to the production of these states by 1—3 glueball(s). The final partial wave analysis of ≈4,000 phiphin events was presented and agrees with prior wave analysis publications withing errors. Alternative explanations in terms of otherwise explaining the OZI suppression breakdown or finding other kinematic mechanisms to explain the BNL/CCNY data are discussed and found to be incorrect and do not fit the characteristics of the experimental data.

2195 **Resonances decaying into phi π/sup +-/s/p/sup +-/s.** Torres, S.; Ficenec, J.; Trower, P.; Lai, K.; Le Britton, J.; Lin, Y.; Pifer, A.; Fenker, H.; Green, D.; Davenport, F. (Virginia Tech, VA). pp 528 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors present results from the Fermilab MPS experiment E623 on the reaction: rho N → phi X at 400 GeV/c beam momentum. Here X includes up to 4 charged particles. The event selection is based on a hardware trigger designed to identify K/sup +/ K/sup -/ pairs produced in the decay of one or more phi mesons. Production distributions in Feynman X/sub F/ and transverse momentum are presented.

2196 **Observation of the Cabibbo-suppressed decay D/sup +-/ → phi π/sup +-/.** Georgiopoulos, C.; Napier, A.; Schneps, J.; Lai, K.; Le Britton, J.; Lin, Y.; Pifer, A.; Fenker, H.; Green, D.; Davenport, F. (Tufts Univ., Boston, MA). pp 527-528 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

From the Fermilab MPS experiment E-623 the authors present cross sections and branching fractions for the Cabibbo suppressed decay of the charmed D/sup +-/ meson to a phi and a π/sup +-/.

2197 Observation of double phi production at 400 GeV/c. Davenport, F.; Albright, J.; Goldman, J.; Hagopian, S.; Lannutti, J.; Lai, K.; Le Britton, J.; Lin, Y.; Pifer, A.; Fenker, H. (Florida State Univ., FL). pp 527 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors have observed phiphi production in the reaction pN -> phiphi + X, where each phi decays to K+K-, at 400 GeV/c using a high-level trigger processor at the Fermilab MPS. Invariant mass and other distributions for phiphi, phiK+K-, and K+K-K+K are presented as well as total inclusive cross sections for phiphi and phiK+K-production.

2198 Measurement of the analyzing power in π/sup +-/p elastic scattering in the region of the roper resonance and below. Mokhtari, A.; Eichon, A.; Kim, G.J.; Nefkens, B.M.K.; Schmitz, S.; Wightman, J.A.; Fitzgerald, D.H.; Briscoe, W.J.; Adrian, S.; Sadler, M.E. (UCLA, Los Angeles, CA). pp 527 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Final results are presented of our experiment to measure the analyzing power, A/sub N/, for π/sup +-/p→π/sup +-/p at 471, 547, 625, and 687 MeV/c in an angular range corresponding to -0.9 ≦ cosΘ/sub cm/ ≦ 0.8. Statistical uncertainties in the data are as low as as 0.02; systematic uncertainties are estimated to be less than 3%. The measurements are compared with the results of existing partial wave analysis from Karlsruhe, CMU-LBL, and the most recent, 1984 results by VPI group. No existing phase shift analysis agrees with all of the data.

2199 Diffraction dissociation in 147 GeV/c π/sup +/p interactions. Fuess, T.; Hafen, E.S.; Pless, I.A.; The, I.; Brick, D.; De, K.; Widgoff, M.; Alyea, D.; Grard, F.; Dolfini, R. (MIT, Cambridge, MA). pp 526 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Diffraction dissociation of both the beam and the target particles is studied in 147 GeV/c π/sup +/p interactions in the Fermilab 30 inch bubble chamber using the hybrid spectrometer system. Results based on a study of 25,000 events are presented and compared to the results of a similar study done on 147 GeV/c π/sup -/p interactions.

2200 Resonance production in 200 GeV/c π/sup -/N interactions. Mikocki, S.; Ficenec, J.; Torres, S.; Trower, P.; Chen, T.; Jenkins, E.; Lai, K.; Le Britton, J.; Lin, Y.; Pifer, A. (Virginia Tech, VA). pp 526 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors present results from Fermilab MPS experiment E580 on the reactions π/sup -/N→V X where V is K/sub s/, Λ or Λ-bar and X are charged particles. Transverse momentum-squared and Feynman X/sub F/ distributions are presented for K/sup π+-/(892) and Σ/sup +-/(1385). The K/sup π+//K/sup π-/ and Σ/sup +/(1385)/Σ/sup -/(1385) ratios are presented as a function of X/sub F/ and compared with various production models.

2201 Leading charged particle charge ratios in high transverse momentum pp and pi-p collisions. Kuehn, C.E.; Erwin, A.R. (Univ. of Wisconsin). pp 525 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A fixed target experiment performed at Fermilab used double-arm calorimeter triggers to study high p/sub t/ clusters of secondary particles produced by +400 GeV/c (pp) and -200 GeV/c (pi-p) beam particles. A magnet downstream from the target produced 0.1 GeV/c deflections for charged particle secondaries. A study has been made of the leading charged particles in the calorimeter trigger regions. The authors find that the ratio (+/-) of the leading charged particles is consistent with a soft gluon structure function for the proton and for the pion.

2202 The electron asymmetry in polarized Σ/sup -/ beta decay: A critical test of the Cabibbo model. Swallow, E.C.; Hseuh, S.Y.; Muller, D.; Tang, J.; Winston, R.; Zapalac, G.; Berge, J.P.; Brenner, A.E.; Grafstrom, P.; Jastrzembski, E. (Dept. of Physics, Elmhurst College, Elmhurst, IL 60126). pp 519-524 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors have used the charged hyperon beam at the Fermilab Tevatron to investigate the beta decay of polarized Σ/sup -/ hyperons. From an initial Σ/sup -/→neν sample of about 25,000 events (roughly one-third of our data), with a Σ/sup -/ polarization of 0.22 +- 0.04, they obtain an electron asymmetry value of α/sub e/ = -0.53 +- 0.05 (statistical) +- 0.04 (systematic) +- 0.12 (polarization). This clearly confirms a characteristic qualitative prediction of the SU(3) model of Cabibbo while previous low-energy polarized Σ/sup -/→neν experiments were in disagreement.

2203 Dimuons at the CERN p-barp collider. Bauer, G. (Univ. of Wisconsin, Madison, WI). pp 491-492 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The author presents results of a search for dimuons from the 1983 run at the CERN p-barp collider. The search yielded 26 events from an integrated luminosity of 108 nb/sup -1/. Five events cluster at high dimuon masses, and are interpreted as Z^0's. The 21 low mass events (4 like sign/17 unlike sign) have diverse characteristics. Some events do not readily conform to expectations.

2204 Measurement of the single jet invariant cross-section at Fermilab. Arenton, M.W. (Argonne National Lab.). pp 526 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The author measured the invariant cross-section for production of jet pairs in 400 GeV/c pp interactions as a function of p/sub T/ in the p/sub T/ range 4 to 9 GeV/c. The results are in good agreement with predictions of perturbative QCD models.

2205 Study of jet production from nuclei at Fermilab. Miettinen, H.E. (Rice Univ.). pp 526 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The author has used a large-acceptance calorimeter to study high transverse energy proton-nucleus collisions at 400 GeV. Two types of geometrically unbiased high E/sub T/ triggers ("global" and "two-high" triggers) were employed to select events from eight nuclear targets (H, He, Be, C, Al, Cu, Sn, Pb). Results on the A dependence of cross sections and event structures will be presented. Also discussed is the evidence for jet production from nuclei.

2206 **Charge flow measurement and its interpretation as quark structure in π/sup +-/p, k/sup +/p and pp interactions at 147 GeV/c.** Milstene, C.; Haridas, P.; Hulsizer, R.I.; Levy, A.; Yamamoto, R.K.; Brick, D.; Widgoff, M.; Alyea, D.; Grard, F.; Dolfini, R. (MIT, Cambridge, MA). pp 526 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The distributions of the net forward and backward charge, in multiparticle production from π/sup +-/p, k/sup +/p and pp collisions at 147 GeV/c, are examined as a function of x Feynman and the rapidity y. For π/sup +-/ and k/sup +/ beams, the total charge in the forward and backward hemispheres is found to be different from the charge of the beam and the target, respectively. This lack of separation between beam and target fragments are examined in the framework of parton models.

2207 **Results from a hadron jet experiment at $\sqrt{s}$ = 19.4 and 27.4 GeV.** Arenton, M.W.; Chen, H.F.; Corcoran, M.; Cormell, L.R.; Ditzler, W.R.; Dris, M.; Erwin, E.R.; Fields, T.; Fleischman, J.; Gardell, E. (Argonne National Lab., Argonne, IL 60439). pp 507-514 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

In Fermilab experiment E609 the authors have studied the production of high p/sub t/ hadron jets by beams of protons at 200 and 400 GeV/c and pions at +- 200 GeV/c. Results for the single-jet and di-jet cross sections are given and are compared to QCD predictions. Leading-particle charge ratios from di-jet events are given and compared to QCD- motivated predictions. Evidence is presented concerning a higher twist effect in πp interactions as predicted by Berger and Brodsky. Preliminary results on high transverse energy events from nuclear targets are given. Finally, the authors present comparisons of their pp high E/sub t/ data with predictions from two Monte Carlo models.

2208 **Search for W → cs-bar and Z → bb-bar, cc-bar at the CERN pp-bar collider.** Ransdell, J. (Univ. of California, Riverside, Riverside, CA). pp 489-490 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Results from a search for two-jet events in which one of the jets contains a muon are discussed. The muon indicates a heavy quark decay (charm, bottom). In 108 nb/sup -1/ of data from the 1983 run of the CERN pp-bar collider, there are 22 such events, 7 of which cluster around the mass of the W and Z bosons. The rate and characteristics of these events are consistent with the processes W → cs-bar and Z → bb-bar, cc-bar.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 1538, 2151, 2173, 2187, 2189, 2190, 2201, 2207, 2325, 2326, 2342, 2432, 2446

2209 **(ATOMKI-A—20-1987) Superstrings on quantum spacetime.** Arvay, Z. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700106/JAW.

A lattice version of superstring theory was introduced by quantising of spacetime. As a natural choice the Planck length was set to be the fundamental length. In the framework of this model interesting new properties of strings were investigated which arise from the basic string mode cancellation. 2 refs.

2210 **(CEA-CONF—8825) Cheshire cat phenomena and quarks in nuclei.** Rho, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Nov 1986. 55p. (CEA-SPhT—86-159; CONF-8607337—1). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87752901/JAW.

From Summer symposium on theoretical physics; Seoul, Korea (7 Jul 1986).

The notion of the Cheshire Cat principle in hadron structure is developed rigorously in (1+1) dimensions and approximately in (3+1) dimensions for up- and down-quark flavor systems. This phenomenon is invoked to address the issue as to whether or not direct quark-gluon signatures can be seen in low-energy nuclear phenomena. How addition of the third flavor -strangeness- can modify the Cheshire Cat property is discussed. It is proposed that one of the primary objectives of nuclear physics be to probe -and disturb- the vacuum of the strong interactions (QCD) and that for this purpose the chiral symmetry SU(3)xSU(3) can play a crucial role in normal and extreme conditions. As an illustration, kaon condensation at a density rho>— $3\mathrm{rho}_0$ is discussed in terms of a toy model and is related to cleansing of the quark condensates from the vacuum.

2211 **(CEA-CONF—8828) Classification of modular invariant partition functions.** Zuber, J.B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Sep 1986. 17p. (CONF-8609303—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752748/JAW.

From 10. John Hopkins workshop on current problems in particle theory; Bonn, F.R. Germany (1 Sep 1986).

Two-dimensional minimal conformal invariant theories are classified, using the constraint of modular invariance of their partition function on a torus.

2212 **(CERN-EP—87-107) Probing quark and lepton substructure at a 2 TeV e^+e^- collider.** Wermes, N. (European Organization for Nuclear Research, Geneva (Switzerland)). 19 Jun 1987. 17p. (CONF-870180—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900053/JAW.

From Workshop on physics at future accelerators; La Thuile, Italy (7 Jan 1987).

The 'reach' of a 2 TeV e^+e^- collider (e.g. CLIC) to probe new physics by detecting the presence of contact interactions is studied. The results are expressed in terms of lower bounds on Λ, the mass scale for lepton and quark substructure. The sensitivity reaches up to 100 TeV for Λ/sub ee/ and Λ/sub eμ/ and between 25 and 80 TeV for Λ/sub eq/. Longitudinal polarization enhances the sensitivity for those helicity configurations which are unfavoured without polarization. Expected lower bounds on Λ are calculated under various conditions. 10 refs., 7 figs., 4 tabs.

2213 **(CONF-8605182—, pp 13-24) CP violation: status and future.** Donoghue, J.F. (Univ. of Massachusetts, Amherst). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

This talk reviews the mechanisms which can produce the observed CP violation in kaons, and discusses some of the possible future directions for the field. The focus on new directions is important because progress cannot be made until some new form of CP nonconservation is observed.

2214 (CONF-8605182—, pp 165-193) **Physics at the Z⁰.** Gilman, F.J. (Stanford Univ., CA). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW. Contract AC03-76SF00515.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

With the next generation of electron-positron colliders on the immediate horizon, they review the standard model and the precision tests of it which can be carried out at the Z⁰ peak. Emphasis is put on the possibilities for discovering new physics, from additional quarks and leptons to extra neutral gauge bosons.

2215 (CONF-8605182—, pp 195-214) **To explore the 1 TeV scale.** Quigg, C. (Fermi National Accelerator Lab., Batavia, IL). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

The author summarizes the case for new physics at the TeV scale, and review speculations about new phenomena which may occur there. He then discusses the physics prospects of a multi-TeV hadron collider, and examines some of the processes which may be studied in detail with such an instrument.

2216 (CONF-8605182—, pp 231-251) **Experimental windows to post-collider energies.** Melissinos, A.C. (Univ. of Rochester, NY). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW. Contract AC02-76ER13065.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

The authors discuss some of the experiments designed to probe the energy regime beyond the reach of existing or proposed accelerators. They attempt to classify the diverse efforts presently underway and give a brief update of the results in the major areas of interest to particle physics. They then describe two detectors presently under construction in the Gran Sasso laboratory, as examples of the next generation of experiments.

2217 (DOE/ER/04928—15) **Partial wave analysis of scattering below 2 GeV: Progress report, May 1, 1987-October 1, 1987.** Arndt, R.A.; Roper, L.D. (Aerospace Corp., Los Angeles, CA (USA). Electronics Research Lab.). 1987. Contract AS05-76ER04928. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001668/JAW.

The Center for Analysis of Particle Scattering (CAPS) in the Department of Physics at VPI and SU has concentrated on analyses of basic several two-body hadron reactions below 2 GeV for the last two decades. Basic reactions under investigation are nucleon-nucleon, pion-nucleon, and K(+)-nucleon elastic systems. In addition to analysis of these systems, a system for disseminating results on VAX backup tapes (SAID) has been developed and over 150 of these computer systems have been sent to laboratories throughout the world.

2218 (IFT-P—09/86) **Production of a new generation of leptons in hadronic collisions.** Eboli, O.J.P.; Marques, G.C.; Novaes, S.F.; Natale, A.A. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1986. 7p. (IFUSP-P—592). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703684/JAW.

The contribution of vector boson fusion processes to the production of a heavy charged lepton accompanied by its neutral partner at multi-TeV hadronic colliders is studied. It is shown that vector fusion dominates over the usual quark-antiquark fusion mechanism, for a very heavy lepton and high energies.

2219 (IFUSP-P—584) **Heavy lepton production via vector boson fusion.** Eboli, O.J.P.; Marques, G.C.; Novaes, S.F.; Natale, A.A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). May 1986. 16p. (IFT—P03/86). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703686/JAW.

The production of a possible pair of sequential heavy charged leptons (M/sup L/ approx. 200-800 GeV) at pp multi-TeV colliders via vector boson fusion, is investigated. The results are compared with the usual Drell - Yan mechanism and with the two photon process. For very heavy leptons the fusion os W's provides a contribution that is, at high energies, larger than the D-Y mechanism.

2220 (INIS-BR—795) **Some studies about conformal invariance in the determination of Schroedinger relativistic equation for free zero mass particles and arbitrary spin.** Siqueira, J.R.R. (Paraiba Univ., Joao Pessoa (Brazil). Dept. de Fisica). 1984. 181p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87703538/JAW.

The question of how far the requirement of invariance under the continuous conformal group determines relativistic Schroedinger wave equations for (free) zero mass particles of arbitrary spin is rised. First, the conditions to be satisfied by the Hamiltonian operator appearing in the Schroedinger wave equation i∂PSI/∂t= H PSI (with PSI transforming locally under homogeneous Lorentz transformations) are derived such that the wave equation is invariant individually under boosts, dilatations and special conformal transformations of the conformal group whose generators are in the local forms given by Mack and Salam for Type Ia fields. Then starting with the most general form of the Hamiltonian for the spin s case, invariant under translations and rotations, the boost, dilatational and special conformal invariance conditions are applied on H so as to make an explicit determination of the solutions for H when psi transforms according (i) D(o,s) (ii) D(s,o) and (iii) D(o,s) + D(s,o) representation of the Homogeneous Lorentz group. (E.G.).

2221 (INIS-BR—796) **Some studies in parastatistical theories and its applications in the internal symmetry of elementary particles.** Silva, H.V. da. (Paraiba Univ., Joao Pessoa (Brazil)). 1984. 188p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87703539/JAW.

The results of investigations in parastatistical theories and in their applications to the internal symmetries of elementary particles are present. The paraquantization and the 'generalized paraquantization' (of Levine and Tomozawa) of the relativistic Schroedinger wave equations for non-zero mass and arbitrary spin (s), involving locally covariant wave functions, PSI/sub o,s/+ PSI/sub s,o/ are executed, and the restrictions resulting from the criterion of microscopic causality and the manner of establishment of the connection between spin and statistics in these quantizations are explicitly demonstrated.

2222 (INIS-SU—422, pp 19-26) **Description of multiple processes on the basis of triagulation in th velocity space.** Baldin, A.M.; Baldin, A.A. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780010/JAW. (JINR-N—17-86).

In JINR rapid communications. Collection.

A method of the construction of polyhedrons in the relative four-velocity space is suggested which gives a complete description of multiparticle processes. A method of the consideration of a general case, when the total number of the relative velocity variables exceeds the number of the degrees of freedom, is also given. The account of the particular features of the polyhedrons due to the clusterization in the velocity space, as well as the account of the existence of intermediate asymptotics and the correlation attenuation principle makes it possible to propose an algorithm for processing much larger bulk of experimental information on multiparticle processes as compared to the inclusive approach. 7 refs.; 1 tab.

2223 (INIS-SU—424, pp 5-17) Unique algorithm for calculation of inclusive cross sections of particle production with large transverse momenta and of cumulative type hadrons. Stavinskij, V.S. 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780011/JAW. (JINR-N—18-86).

In JINR rapid communications. Collection.

Unique algorithm is proposed for calculating inclusive cross sections of particle production with large transverse momenta and cumulative type hadrons. A possibility of unique description of these processes is due to introduction of a new argument - of minimal energy of colliding constituents needed for the production of observed particle. A comparison with experimental data are carried out. 26 refs.; 3 figs.

2224 (INS—609) Hadronization of the quark-gluon plasma. Mueller, B.; Sano, M.; Sato, H.; Schaefer, A. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703585/JAW.

We construct a model for hadronization of the quark-gluon plasma, based on the relativistic coalescence model. We relate the coalescence amplitude to the one-particle Wigner function for quarks in the plasma. The relation between the Wigner function and the nucleon structure function is pointed out. We derive explicit expressions for the production of mesons and baryons in the framework of the relativistic harmonic oscillator model of hadronic structure.

2225 (INS—616) Mass spectrum of composite quarks, leptons, weak bosons and Higgs scalars. Terazawa, Hidezumi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Dec 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703591/JAW.

How and to what extent we can predict or understand the mass spectrum of composite quarks, leptons, weak bosons and Higgs scalars are discussed in a minimal composite model. The Higgs scalar mass and the top quark mass are predicted to be m/sub eta/ $\simeq (2/\sqrt{3})$m/sub W/ $\simeq$ 95 GeV and m/sub t/ $\simeq \sqrt{(8/3)}$m/sub W/ $\simeq$ 134 GeV if there are only three generations. If there are four generations, the average mass of the fourth generation of quarks and leptons is also about 95 GeV. The relation of m/sub c// m/sub s/ = (4 m/sub d/-m/sub u/)/(4 m/sub u/-m/sub d/), the sum rule of m/sub e//sup 1/2/-m/sub ν(sub e)//sup 1/2/ = m/sub d//sup 1/2/-m/sub u//sup 1/2/, the mass formula of m/sub f/ = (m/sub W/-m/sub C/)/sup 2//Λ and a possible mass hierarchy of generations are presented.

2226 (INS—618) Dynamical model for composite quarks and leptons. Yasue, Masaki. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jan 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750057/JAW.

In supersymmetric quantum chromodynamics (SQCD) with N-"colors" and M-"flavors" (N < M), quarks are generated as quasi Nambu-Goldstone fermions in c/sub a/w/sub i/ and leptons as chiral fermions in ϵ/sup abc/c/sub a//sup C/c/sub b//sup C/c/sub c//sup C/w/sub i/ (N = 4) with antisymmetrized "colors" (a = three colors, i = weak isospins). Mass protection symmetry is SU(N - 1)/sub L+R/ x SU(M - N + 1)/sub L/ x SU(M - N + 1)/sub R/ x [U(1)'s] supported by complementarity and effective superpotential. The remaining chiral symmetries are all broken by supersymmetry-breaking mass M/sub SS/ << the scale of SQCD Λ/sub sc/. The mass scale for quarks and leptons is provided by M/sub SS/(M/sub SS//Λ/sub sc/)/sup α/ with α = (M-N)/[2rho - (M - N - 2)] for 2rho > M - N - 2.

2227 (INS—620) Monopoles from superstring theory. Midorikawa, Shoichi; Tomiya, Mitsuyoshi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jan 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750058/JAW.

The non-Abelian magnetic monopoles associated with symmetry breaking by the compactification of extra dimensions is considered. It is shown that the spherically symmetric monopoles which satisfy the twisted boundary condition on the space cannot exist.

2228 (INS—621) Dynamical models for composite quarks and leptons based on supersymmetric quantum chromodynamics. Yasue, Masaki. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750059/JAW.

Dynamical properties of SQCD with N-"colors" and M-"flavors" are discussed to see the feasibility of SQCD as underlying dynamics for composite quarks and leptons. There are four cases with N $\leq$ M that accommodate composite quarks and leptons being quasi Nambu-Goldstone fermions. Quarks and leptons without phenomenologically dangerous light leptoquarks can be provided in the two cases with N = 4 and M > N, which possess as mass-protection symmetries either (A) SU(N)/sub L+R/ x SU(M - N)/sub L/ x SU(M - N)/sub R/ x [two U(1)'s] or (B) SU(N - 1)/sub L+R/ x SU(M - N + 1)/sub L/ x SU(M - N + 1)/sub R/ x [three U(1)'s] consistent with complementarity and effective superpotential. SUSY- and chiral-symmetry-breakings are included in the form of effective lagrangian and masses for light composite fermions are found to be controlled by the SQCD scale Λ/sub sc/ and the SUSY-breaking scale M/sub SS/(Λ/sub sc/ >> M/sub SS/) as M/sub SS/(M/sub SS//Λ/sub sc/)/sup (M-N)/κ/ with κ = 2rho - (M - N) > 0 for (A) and κ = 2rho - (M - N - 2) > 0 for (B).

2229 (INS—626) Way from string to soliton. Introduction of KP coordinate to string amplitudes. Sogo, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750065/JAW.

By the use of Tomonaga's boson-fermion correspondence, we show explicitly the equivalence of vertex operators in three apparently different theories: bosonic string theory, tau function theory and soliton theory of Kadomtsev-Petviashvili (KP) hierarchy. Amplitude with arbitrary external momenta and with KP coordinates is calculated for tree and one-loop level in open bosonic string theory.

2230 (INS—627) Composite model of the space-time and 'colors'. Terazawa, Hidezumi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750064/JAW.

A pregeometric and pregauge model of the space-time and "colors" in which the space-time metric and "color" gauge fields are both composite is presented. By the non-triviality of the model, the number of space-time dimensions is restricted to be not larger than the number of "colors". The long conjectured space-color correspondence is realized in the model action of the Nambu-Goto type which is invariant under both general-coordinate and local-gauge transformations.

2231 (INS—629) Possible neutrino oscillation in the observed neutrino burst from SN1987a. Midorikawa, S.; Terazawa, H.; Akama, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Apr 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750041/JAW.

The KAMIOKANDE-II and IMB data on the neutrino burst from the supernova SN1987a are analyzed for possible neutrino oscillation. Especially pointed out is the possibility that a periodic structure in the observed spectrum of inverse electron neutrino energies can be explained by the extremely small mass-squared difference of Δm/sup 2/ = (7.2 +- 0.4) x 10/sup -20/eV/sup 2/.

2232 (INS—630) Finite temperature renormalization group equation in QCD. Fujimoto, Yasushi; Yamada, Hirofumi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Apr 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750042/JAW.

A scheme of renormalization group approach at finite temperature is applied to QCD to investigate the behaviour of the effective coupling constant with respect to both temperature and momentum scale. It is found that the coupling constant decreases with temperature for fixed momenta. We also find that in a particular direction where both momenta and temperature are changed at the

same rate the coupling constant behaves in the same manner as in zero temperature.

2233 **(LA-UR—87-1878) Future directions in interplays between particle and nuclear physics: Summary session.** Garvey, G.T. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 31p. (CONF-870413—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE87011791/JAW.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

This paper contains the summary comments on a session of the International Conference on Particles and Nuclei. The author discusses topics such as: rare decays forbidden in the Standard Model, various properties of the MEGA detector, broken symmetries in strongly interacting systems, and the need for a high-intensity high-energy facility in nuclear physics. (LSP)

2234 **(LYCEN—8616) Multiparticle distributions in limited rapidity intervals and the violation of asymptotic KNO scaling.** De Dias Deus, J. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Mar 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752725/JAW.

A simple model independent analysis of UA5 collaboration pantip collider data on rapidity cut charged particle distributions strongly suggests: i) independent particle emission from sources or clusters; ii) exact negative binomial multiparticle distributions. The violation of asymptotic KNO scaling is shown to arise from the fast growth with energy of the reduced correlations C/sub K/ (O)/C/ sub 1//sup k/ (0). A comparison with recently published e/sup +/ e/sup -/ $\sqrt{s}$ = 29 GeV data is presented.

2235 **(N—87-25772) Hypercube matrix computation task. Final report, 1986-1987.** Calalo, R.; Imbriale, W.; Liewer, P.; Lyons, J.; Manshadi, F.; Patterson, J. (Jet Propulsion Lab., Pasadena, CA (USA)). Jul 1987. 122p. (NASA-CR—180921; NAS—1.26:180921; JPL-PUB—87-18). NTIS, PC A06/MF A01.

The Hypercube Matrix Computation (Year 1986-1987) task investigated the applicability of a parallel computing architecture to the solution of large scale electromagnetic scattering problems. Two existing electromagnetic scattering codes were selected for conversion to the Mark III Hypercube concurrent computing environment. They were selected so that the underlying numerical algorithms utilized would be different thereby providing a more thorough evaluation of the appropriateness of the parallel environment for these types of problems. The first code was a frequency domain method of moments solution, NEC-2, developed at Lawrence Livermore National Laboratory. The second code was a time domain finite difference solution of Maxwell's equations to solve for the scattered fields. Once the codes were implemented on the hypercube and verified to obtain correct solutions by comparing the results with those from sequential runs, several measures were used to evaluate the performance of the two codes. First, a comparison was provided of the problem size possible on the hypercube with 128 megabytes of memory for a 32-node configuration with that available in a typical sequential user environment of 4 to 8 megabytes. Then, the performance of the codes was anlyzed for the computational speedup attained by the parallel architecture.

2236 **(NBI-HE—87-16) Chiral soliton model with dynamical restoration of chiral symmetry from quark flavour dynamics.** Reinhardt, H.; Kaempfer, B. (Niels Bohr Inst., Copenhagen (Denmark); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Mar 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750030/JAW.

The Nambu-Jona-Lasinio model as a particular model of quark flavour dynamics is bosonized in the low-energy regime using a generalized heat kernel expansion with local mass scale. The resulting effective meson Lagrangian define a chiral solition model, the solutions of which show a partial restoration of chiral symmetry inside the soliton.

2237 **(NBI-HE—87-18) Electroweak production of baryon asymmetry and upper bounds on the Higgs and top masses.** Bochkarev, A.I.; Shaposhnikov, M.E. (Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Apr 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750032/JAW.

We determine the upper bound on the Higgs boson mass from the condition that baryon asymmetry produced during the electroweak phase transition should not be diluted by the anomalous electroweak baryon number nonconserving proceses. The value is insensitive to the mass of t-quark and equal to 45 GeV, slightly depending on the magnitude of the preexponential factor in the rate of the B non-conservation. This gives also upper bound on the top quark mass m/sub t/ $<$ 80 GeV.

2238 **(NBI-HE—87-27) On the structure of the low energy superpotential in superstring theory.** Krasnikov, N.V.; Rozhansky, L.V. (Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). May 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750033/JAW.

We show that after the gauge symmetry breaking of the E/ sub 6/ grand unified group to the H = SU(3)/sup C/ x SU(2)/sub L/ x U(1)/sub Y/ x U(1)/sub E/ subgroup by the Hosotany mechanism a number of additional Yukawa terms not present in a decomposition of 27 x 27 x 27 may appear in the low energy superpotential. Some of these terms cause a rapid proton decay.

2239 **(RAL—87-002) Determination of limits on the number of light neutrinos and the top quark mass from W, Z production in pp-bar collisions.** Martin, A.D.; Stirling, W.J.; Roberts, R.G. (Rutherford Appleton Lab., Chilton (UK)). Jan 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752945/JAW.

The ratio of the (acceptance corrected) number of W's and Z's observed at the CERN collider is compared with the prediction of the Standard Model. Possible sources of error are carefully studied. A new analysis of deep inelastic data is performed in order to significantly improve the accuracy of the Standard Model prediction. The implications for the number of light neutrinos and the mass of the top quark are discussed.

2240 **(RAL—87-020) Low energy $\gamma\gamma$ yields $\pi\pi$ cross-section and the QED Born amplitude.** Morgan, D.; Pennington, M.R. (Rutherford Appleton Lab., Chilton (UK)). Mar 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752951/JAW.

Recent experiments at Petra and DCI have measured the near threshold cross-section for $\gamma\gamma \to \pi^+\pi^-$ and found a significant enhancement when compared with the QED Born amplitude controlled by one pion exchange. Several explanations for this have been proposed by introducing suitably modelled s-channel dynamics. The authors show that general analytic and unitarity properties make such an enhancement a priori unlikely. Consequently, either experimental data and its modelled explanations violate these general principles or some experiments are wrong. Data on $\gamma\gamma \to$ πsup(0) πsup(0) will decide.

2241 **(SLAC-PUB—4385) Two current experimental problems in heavy lepton physics: tau decay modes and close mass pairs.** Perl, M.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Aug 1987. Contract AC03-76SF00515. 11p. (CONF-8705198—2). NTIS, PC A02. Order Number DE88000702/JAW.

From 2. topical seminar on heavy flavour physics; San Miniato, Italy (25 May 1987).

This paper investigates tau lepton decay modes and close-mass lepton pairs. The major part of the paper discusses branching functions from experimental and theoretical viewpoints. Finally, the lack of experimental signatures of close-mass lepton pairs are reviewed. 15 refs., 2 figs., 11 tabs. (JDH)

2242 Adler's overrelaxation algorithm for Goldstone bosons. Neuberger, H. (Department of Physics and Astronomy, Rutgers University, Piscataway, New Jersey 08855). *Physical Review Letters;* **59**: No. 17, 1877-1880(26 Oct 1987).

A very simple derivation of a closed-form solution to the stochastic evolution defined by Adler's overrelaxation algorithm is given for free massive and massless scalar fields on a finite lattice with periodic boundary conditions and checkerboard updating. It is argued that the results are directly relevant when critical slowing down reflects the existence of Goldstone bosons in the system.

2243 Production of new charged leptons decaying into massive neutrinos. Barnett, R.M.; Haber, H.E. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 7, 2042-2046(1 Oct 1987). Contract AC03-76SF00098.

A recent paper from Perl pointed out that existing limits from e^+e^- annihilation data for a fourth-generation charged lepton L^+ were not valid if the mass splitting between the lepton and its associated neutral lepton were small. The purpose of this paper is twofold: to urge experimentalists at hadron colliders to examine limits for charged leptons without assuming $M(L^0) = 0$, and to provide the necessary formulas for the widths and matrix elements. The formulas presented here assume couplings with arbitrary vector and axial-vector pieces and are thus applicable to the production and decay of other fermions such as right-handed leptons and supersymmetric fermions. We present some sample cross sections for $W^+ \rightarrow L^+ L^0$ applicable to the CERN Spp-barS collider.

2244 Comments on the electron anomalous magnetic moment between conducting plates. Tang, A.C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 7, 2181-2184(1 Oct 1987). Contract AC03-76SF00515.

The mathematics of computing the difference of a divergent sum and integral is explored and the implications for the derivation of the electron g-2 between conducting plates explained.

2245 Testing the standard model versus a composite structure of weak interactions in high precision experiments at LEP and SLC. Baur, U.; Lindner, M.; Schwarzer, K.H. (Fermi National Accelerator Lab., Batavia, IL, USA; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen, Germany, F.R.. Werner-Heisenberg-Inst. fuer Physik; Muenchen Univ., Germany, F.R.. Sektion Physik). *Nuclear Physics* [*Section*] *B;* **291**: No. 1, 1-40(17 Aug 1987).

Models with a composite structure of the weak interactions usually contain an isoscalar weak vector boson Y or Y/sub L/ which is coupled to the weak hypercharge current, or its left-handed part. We study the impact of Y and Y/sub L/ on the Z-boson parameters and other measurables at future high energy e/sup +/e/sup -/ colliders and discuss the corresponding standard model predictions. An analysis of the forward-backward and left-right asymmetry for the general case of two massive vector bosons with arbitrary vector and axial vector coupling constants is undertaken which may be applied to any other model containing additional weak vector bosons. If experiments at LEPI/SLC and LEPII agree with the standard model predictions within the possible experimental accuracies, Y(Y/sub L/) bosons with a mass of up to 1 TeV (0.9 TeV) could be excluded.

2246 Excited weak vector bosons facing the high energy and high precision frontier. Baur, U.; Lindner, M.; Schwarzer, K.H. (Fermi National Accelerator Lab., Batavia, IL, USA; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen, Germany, F.R.. Werner-Heisenberg-Inst. fuer Physik; Muenchen Univ., Germany, F.R.. Sektion Physik). *Physics Letters* [*Section*] *B;* **193**: No. 1, 110-116(9 Jul 1987).

If the recently discovered weak bosons W/sup +-/ and Z were manifestations of a composite structure of the weak interactions rather than the commonly assumed gauge bosons of a fundamental gage symmetry one is naturally led to expect a corresponding spectrum of excited weak vector bosons. Experiments at LEP I/SLC and LEP II may be uniquely suited to shed light on this question with their power to perform high precision tests of the standard model.

2247 (DESY-L-Trans—321) About the mechanism of charmed quark excitation in inclusive production of d-mesons. Bednyakov, V.A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). Apr 1987. Translation of Preprint JINR-P2—86-739. 13p. Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany, F.R.

Translated from Russian .

D-meson inclusive pp-production by hard QCD excitation of charmed sea quark (qc -> qc, gc -> gc) was investigated. Charmed mesons are produced through recombination of charmed quark with quarks from initial protons. The recombination process is described phenomenologically in the language of a modified recombination function which permits to take into consideration the whole C-quark kinematical interval. The probability of fragmentation of an initial proton into a set of quarks necessary for the production of a charmed meson with the given quantum numbers is assigned by two-particle distribution functions. Free parameters have been determined from the data analysis. Two allowed channels of charmed meson production by excitation mechanism was considered in lowest charm quark sea approximation. It is demonstrated that the excitation mechanism permits to describe the shape of meson momentum spectrum as well as production mechanism (qq -> c, gg -> cc). Momentum spectra and invariant differential cross sections of pp-productions of D/sup 0/-, D/sup 0/-, D/sup +/, D/sup -/-mesons have been calculated at $\sqrt{5} = 6$ GeV and X/sub F/ > 0. The possibility of a specific maximum for excitation mechanism in momentum spectra of charmed mesons at low X/sub F/ was stressed.

2248 Hadron cascades produced by electromagnetic cascades. Nelson, W.R.; Jenkins, T.M.; Ranft, J. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 573-583 of Health physics of radiation generating machines 20th midyear topical symposium. Swanson, W.P.; Busick, D.D. Springfield, VA; National Technical Information Service (1987). (CONF-870219—). Contract AC03-76SF00515.

From 20. midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

A method for calculating high energy hadron cascades induced by multi-GeV electron and photon beams is described. Using the EGS4 computer program, high energy photons in the EM shower are allowed to interact hadronically according to the vector meson dominance (VMD) model, facilitated by a Monte Carlo version of the dual multistring fragmentation model which is used in the hadron cascade code FLUKA. The results of this calculation compare very favorably with experimental data on hadron production in photon-proton collisions and on the hadron production by electron beams on targets (i.e., yields in secondary particle beam lines). Electron beam induced hadron star density contours are also presented and are compared with those produced by proton beams. This FLUKA-EGS4 coupling technique could find use in the design of secondary beams, in the determination high energy hadron source teams for shielding purposes, and in the estimation of induced radioactivity in targets, collimators and beam dumps.

2249 Technique to search for a heavy sequential charged lepton at anti pp colliders. Mohammadi, M. (Univ. of Wisconsin, Madison). pp 1-22 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The present limit on the mass of a heavy sequential charged lepton (L) is 22 GeV/c^2. W → L + anti nu/sub L/ decay gives a kinematic range of the mass of L up to 70 GeV/c^2 to search for such particles. In this paper the importance of the decay mode L → q + anti q' + nu/sub L/ for heavy lepton production at p anti p

colliders is pointed out. Using realistic Monte Carlo calculations with detector simulations for the signal and background, the expected signal for the present UA1 data is indicated.

2250 **Detection of low mass Higgs boson at the anti pp colliders.** Cline, D.B. (Univ. of Wisconsin, Madison). pp 23-29 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The author shows how it is possible to detect a low-mass Higgs boson at a p anti p collider using W + Higgs final states. The best signatures for observation are explored for the S p anti pS and TeV I energy range (i.e. for the UA1 and CDF detectors). The author also reviews the present mass limitations on the Higgs boson. In addition, the Coleman-weinberg Higgs boson mass could be very small as well (M/sub H//sup C.W./ < 10.8 GeV) if m/sub t/ > 50 GeV.

2251 **Limits on predictability of supercollider physics.** Ralston, J.P.; McKay, D.W. (Univ. of Kansas, Lawrence). pp 30-38 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract FG02-85ER40214.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors discuss present limitations on the predictability of ultrahigh energy cross sections in QCD. Assuming coupled Altarelli-Parisi evolution, they exhibit kinematic boundaries in the x, Q^2 plane beyond which no reliable predictions can now be made. The boundaries occur for any large Q^2 for small enough x, and follow from the effects of boundary conditions on small-x asymptotic estimates. A typical boundary occurs at $1/x \geq [\ln(Q^2/\Lambda/\text{sub QCD}/^2)/\ln(Q_0{}^2/\Lambda/\text{sub QCD}/^2)]/\text{sup mb}/8N/$ where m depends on theoretical models. Such boundaries occur in phenomenologically important regions, and are distinct from the unitarity boundaries discussed by Gribov, Levin, and Ryskin: the unpredictable regions could be predicted with new data at medium Q^2 and small x. They also discuss the possibility of significant effects throughout the SSC kinematic regions from unexpected consequences of unitarity boundary conditions. 11 references, 2 figures.

2252 **Low E/sub T/ jets from UA1.** Albajar, C. (CERN, Geneva, Switzerland). pp 39-55 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

High E/sub T/ jets (E/sub T/ > 20 Gev) have been intensively studied in the last few years by the UA1 Collaboration at the CERN SPS Proton-Antiproton Collider. In this talk they present results from the analysis of the low E/sub T/ jets (E/sub T/ < 20 Gev) coming from a sample of minimum-bias-trigger events. 13 references, 14 figures.

2253 **QCD jets: a perturbative approach to low-pt physics.** Pancheri, G.; Srivastava, Y.N. (INFN, Frascati, Italy). pp 56-76 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The contribution of QCD Jets to the rise with energy of the inelastic cross-section is discussed quantitatively and found to be large. It is seen that the inclusive jet yield is the fastest growing component of the total cross-section. The dependence of this yield upon the rapidity cuts, the choice of parton densities, the ACD scale Q_3 and the transverse momentum cutoff p_0 are examined. At higher energies, multiple parton scattering processes are seen to be non-negligible. Extrapolations of the jet yield to the Tevatron and beyond are also presented. 24 references, 7 figures, 1 table.

2254 **Low P/sub perpendicular to/ properties of the Pomeron - theoretical implications in QCD.** White, A.R. (Argonne National Lab., IL). pp 77-88 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Experimentally established properties of the Pomeron which cannot be explained within perturbative QCD are reviewed and their theoretical significance elaborated on. The derivation from QCD of a semi-perturbative Pomeron, which has such properties, is described in terms of infra-red divergences of reggeon diagrams and in terms of an infinite momentum winding number condensate due to instanton interactions. The analogy with the known solution of the Schwinger model is emphasized. Asymptotic freedom saturation is needed to justify this picture of the Pomeron and this is satisfied at collider energies if electroweak symmetry breaking is due to color sextet quarks. 24 references.

2255 **Inelastic cross-section at $\sqrt{s} \sim 40$ TeV.** Stanev, T. (Univ. of Delaware, Newark). pp 141-152 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

This talk contains a description of the derivation of the inelastic proton-air cross-section from the depth of maximum distribution of cosmic ray air showers and an attempt to analyze the systematic errors in this type of measurement. The conclusion is that, if scaling is not strongly violated in the fragmentation region, the Fly's Eye value of $\sigma/\text{sup p-air}//\text{sup in}/ = 540 +/- 50$ mb is a lower limit. 13 references, 6 figures.

2256 **Hadron cross sections at ultra high energies.** Yodh, G.B. (Univ. of Maryland, College Park). pp 153-165 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

A review of results on total hadronic cross sections at ultra high energies obtained from a study of longitudinal development of cosmic ray air showers is given. The experimental observations show that proton-air inelastic cross section increases from 275 mb to over 500 mb as the collision energy in the center of mass increases from 20 GeV to 20 TeV. The proton-air inelastic cross section, obtained from cosmic ray data at $\sqrt{s} = 30$ TeV, is compared with calculations using various different models for the energy variation of the parameters of the elementary proton-proton interaction. Three conclusions are derived. (1) The diffractive dissociation cross section for proton-air interactions is determined with an uncertainty of less than 3% because unitarity bounds the diffractive cross section from above. (2) Current models in which the proton-proton total cross section has an energy dependence of the form, $c + d\ln^2(s)$, are favored by cosmic ray data. (3) The proton-proton total cross section at $\sqrt{} = 30$ TeV should be ≥ 130 mb, if the elastic slope parameter is less than 30 GeV^{-2}. 29 references, 7 figures.

2257 **QCD and rising total cross sections.** Durand, L.; Hong, P. (Univ. of Wisconsin, Madison). pp 166-177 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract AC02-76ER00881.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors show that parton-parton scattering processes in QCD drive a rapid increase in the proton-proton total scattering cross section at high energies, and use a diffraction scattering formalism to obtain quantitative predictions for $\sigma/\text{sub tot}/$ at SSC and cosmic ray energies. They also predict a very rapid increase in the number of minijet events. 13 references, 6 figures.

2258 Rising hadron-hadron total cross sections and gluons. Margolis, B.; Valin, P. (McGill Univ., Montreal, Quebec). pp 178-185 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors discuss the case for rising hadron total cross sections being the result of gluon-gluon interaction. The authors present an eikonal approach to the problem. The eikonal is separated into two terms, a constant contribution from valence quarks and a gluon-gluon initiated contribution.

2259 Multiplicities without KNO. Durand, B. (Univ. of Wisconsin, Madison). pp 186-192 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors give a recent result showing that a parton branching model for the multiplicity probability P/sub mn/ of m quarks and n gluons will always have an exact solution which violates KNO scaling. When quarks are not counted, the first approximation solution for gluons is automatically a KNO function, with higher order corrections approaching the KNO function from below in the high-z tail. That is, the distribution broadens as n increases, in agreement with recent collider data. 10 references, 2 figures.

2260 Multistring fragmentation model from ISR to SSC energies. Aurenche, P.; Bopp, F.W.; Ranft, J. (LAPP, Annecy-le-Vieux, France). pp 193-207 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors report on a particle production model for soft hadronic collisions. The model is based on dual-Regge ideas and involves the production of strings which subsequently decay independently. The model is in agreement with the experimental features such as the rise with energy of the multiplicity and the rapidity plateau, the violations of KNO scaling, the forward-backward correlations... Extensions of the model to the semi-hard scattering region are proposed and shown to agree with the data on the rise of the transverse momentum of secondaries with the particle density in the central region at the CERN collider. The relevance of the model for mini-jet events is also discussed. Finally extrapolations to SSC energies are presented. 23 references, 15 figures.

2261 Understanding the transition jets - no jets at fixed-target energies. Corcoran, M.D. (Rice Univ., Houston, TX). pp 238-255 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Data from fixed-target, large-solid angle calorimeter jet experiments is reviewed. Comparisons are made with a few Monte Carlo models. Models using independent fragmentation and having soft spectator jets (ISAJET 5.20 and the independent fragmentation options in the LUND model) are found to be in good agreement with the data. Models using cluster or string fragmentation (LUND string of Field-Fox-Wolfram models) are not in agreement with the data. Jet experiments at fixed-target energies have been somewhat controversial. It is certainly more difficult to observe jets at these energies than at collider energies, but with the appropriate triggers it is quite possible. In this talk the author will first give a brief survey of data from large-solid-angle calorimeter experiments at fixed-target energies. The second part of the talk will be a comparison of the data with a few Monte Carlo models, with particular emphasis on the uncertainties in the models and the importance of the spectator systems. 20 references, 16 figures.

2262 Isolating hard scattering effects in minimum bias data. Maxwell, C.J. (Univ. of Durham, England). pp 256-264 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors attempt to explain the multiplicity distributions measured by UA5 at the CERN anti pp collider with a simple two-component description. The data support such a picture. The hard component extracted from data is compared with expectations from QCD $2 \rightarrow 2$ parton-parton scattering, and jet calculus results on multiplicity distributions in jets, with encouraging agreement given the many theoretical uncertainties. 16 references, 6 figures, 1 table.

2263 Evidence for B^0 mixing from same-sign dimuons produced in anti pp collisions. Cline, D.B. (CERN, Geneve, Switzerland). pp 278-298 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors report on the latest dimuon sample from the UA1 experiment at the Sp anti pS collider. The data are best understood in terms of substantial B^0 mixing. Theoretical expectations lead to the conclusion that the B/sub s/^{0} - anti B/sub s/^{0} is mixed. The authors briefly mention the possibility of searching for CP violation in the B/sub s/^{0} system. 10 references, 7 figures, 8 tables.

2264 Model for Centauro production. Goulianos, K. (Rockefeller Univ., New York, NY). pp 299-312 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors discuss briefly some features of the Centauro-type events reported by cosmic ray experiments and present a phenomenological model for their production, based on the hypothesis of a QCD phase transition in coherently produced diffractive fireballs. 10 references, 3 figures, 3 tables.

2265 Hard diffractive processes: QCD models. Berger, E.L.; Collins, J.C.; Soper, D.E.; Sterman, G. (Argonne National Lab., IL). pp 313-330 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract W-31-109-ENG-38.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors discuss high energy hadron collisions that contain a hard scattering, in the sense that a W, a Z, very heavy quarks, or high P/sub T/ jets are produced, yet are diffractive, in the sense that one of the incident hadrons is scattered with only a small energy loss. In their approach, the cross section for such diffractive hard scattering is a part of the normal hard scattering inclusive cross section, as calculated using perturbative quantum chromodynamics. They use Regge phenomenology in combination with perturbative QCD to estimate that a substantial fraction (perhaps 30% of all hard scattering events are diffractive. Measurement of diffractive hard scattering cross sections would illuminate the short distance gluon and quark content of the Pomeron. 23 references, 7 figures, 2 tables.

2266 Multiple parton-parton interactions and the effects of varying impact parameters. Sjoestrand, T. (Fermi National Accelerator Lab., Batavia, IL). pp 331-340 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The possibility of having several independent parton-parton interactions in a hadron-hadron collision is studied. A simple framework is developed for the effects of varying impact parameters. Properties studied include multiplicity distributions, forward-backward correlations, minijet rates and average transverse momentum dependence on multiplicity. 7 references, 4 figures.

2267 **Diffractive heavy flavor production-including W/sup +/-/ and Z°.** White, A.R. (Argonne National Lab., IL). pp 341-347 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

It is shown that when the Pomeron has the semiperturbative origin in QCD described in a companion talk, diffractive heavy quark production is independent from, and not suppressed relative to, the perturbative gluon fusion process. It is emphasized that anomalously large diffractive heavy flavor cross-sections could anticipate correspondingly large cross-sections for the diffractive production of W/sup +/-/ and Z°-providing distinctive evidence for the dynamical nature of the electroweak Higgs sector. 7 references.

2268 **Identifying heavy Higgs bosons.** Cahn, R.N. (Univ. of California, Berkeley). pp 348-354 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract AC03-76SF00098.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Two techniques for identifying heavy Higgs bosons produced at SSC energies are discussed. In the first, the Higgs boson decays into ZZ, with one Z decaying into an e-pair or μ-pair and the other into a neutrino pair. In the second, the production of the Higgs boson by WW fusion is tagged by detecting the quarks that produced the bremsstrahlung virtual W's. The associated Higgs decay is identified by one leptonic and one hadronic decay. Both methods appear capable of finding a heavy Higgs boson provided the SSC design parameters are achieved. 16 references, 2 figures, 2 tables.

2269 **Experimental searches for W pairs and Higgs at a very high energy PP collider.** Savoy-Navarro, A. (CEN-Saclay, Gif-sur-Yvette, France). pp 355-377 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

This report is a brief summary of the two talks given at this Workshop. It reviews the results obtained so far by the working group which studies how to detect W pairs and Higgses at the SSC. The main emphasis is given to the progresses made since the UCLA meeting. They first study the possibilities to detect low mass Higgses (i.e. < 2 m/sub W/) at present (FNAL) or future hadron-hadron colliders. They then summarize the main detection problems, encountered in the search for a high mass Higgs (i.e., with a mass larger than 2 m/sub W/). New tools are developed to identify and measure W's when they decay hadronically. 7 references, 11 figures, 4 tables.

2270 **Superstrings and the SSC.** Hinchliffe, I. (Univ. of California, Berkeley). pp 378-386 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract AC03-76SF00098.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

A brief overview of the phenomenological consequences of superstrings is given. Emphasis is placed on those models which have new particles in the mass range accessible at the SSC. 22 references, 1 table.

2271 **Physics of charm, beauty, and beyond.** Chau, L. (Univ. of California, Davis). pp 387-424 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The phenomena of quark mixing in weak interaction are described. The current experimental status of the mixing matrix, charm, and beauty particle decays, and CP violations are reported. Future interesting experiments are pointed out, especially in the event that higher generations of quarks exist. 61 references, 5 figures, 2 tables.

2272 **Distribution of heavy particles in the proton.** Haber, H.E.; Soper, D.E.; Barnett, R.M. (Univ. of California, Santa Cruz). pp 425-441 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

At the SSC, heavy colored particles can make up a sizeable fraction of the proton's momentum. Thus, processes involving such heavy particles can occur in two distinct ways: via hard scattering of light quarks and gluons or via the hard scattering of the heavy constituents. They develop a technique to compute both processes consistently in perturbative QCD without double counting. The method is exhibited in the calculation of supersymmetric particle production. 22 references, 6 figures.

2273 **Assessment of Monte Carlo models for high energy hadronic collisions.** Gottschalk, T.D. (California Institute of Technology, Pasadena). pp 453-493 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract AC03-81ER40050.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Standard model Monte Carlo simulations of high energy hadron-hadron scattering are reviewed. Various components common to most models are examined, including parton distribution functions, hard parton subprocesses, initial and final state parton shower evolution, hadronization schemes and pictures for beam remnants. Particular attention is given to recent improvements in event simulation schemes and to remaining unsolved problems. 118 references, 19 figures.

2274 **Mixing and CP violation in B and D decays - future searches at hadron machines.** Bigi, I. (Stanford Univ., CA). pp 494-503 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The standard Model predicts sizeable if not even maximal B/sub s/ - anti B/sub s/ mixing; B/sub d/ - anti B/sub d/ mixing is not expected to exceed the one percent level unless top quarks are very heavy (m/sub t/ $\geq$ 150 GeV). B decays also offer the best opportunity to discover CP violation outside the neutral K system. Employing the standard model one predicts - with reasonable confidence - CP asymmetries of up to 20% (or even more in some cases). The branching ratios for the individual exclusive modes of interest are not expected to exceed the 10^{-3} level in most cases; the identification of such decays poses non-trival problems. It is shown that by summing intelligently over appropriate classes of decays one can greatly enhance statistics without jeopardizing the signal. Very similar searches can be performed for D decays. 11 references, 4 tables.

2275 **Non accelerator physics - proton decay.** Nath, P.; Arnowitt, R. (Northeastern Univ., Boston, MA). pp 504-514 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

A review of the current status of proton decay in grand unified theories with and without supersymmetry is given. 37 references, 1 figure, 4 tables.

2276 **Supersymmetric signals at accelerators.** Arnowitt, R.; Nath, P. (Northeastern Univ., Boston, MA). pp 515-523 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Supersymmetric signals arising from Wino (anti W) and Zino (anti Z) decays of W and Z bosons are described. Predictions of event rates and distributions are given for hadronic decays of anti W and anti Z (monojet and dijet events) as well as leptonic decays (e.g., $Z \rightarrow \mu$ + e/sup +/-/ + p/sub T/ events). 13 references, 4 figures, 6 tables.

2277 **Searching for gauginos at hadron colliders.** Baer, H.; Hagiwara, K.; Tata, X. (Argonne National Lab., IL). pp 524-537 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract AC02-76ER00881.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

It is shown that if the decays W → anti W anti Z and Z^0 → anti WW are kinematically accessible, monojet + p/sub T/, dijet + p/sub T/ and multilepton + p/sub T/ events occur at a substantial rate. They present rates and some distributions for these processes incorporating experimental resolutions, acceptances and triggers for both CERN and Fermilab Tevatron energies. It is suggested that it may be possible to extract limits on anti W and anti Z masses from the present UA1 data sample that are more stringent than those available from present e^+e^- experiments. 18 references, 8 figures.

2278 **CP violation in decays of W and Z bosons.** Soni, A. (Univ. of California, Los Angeles). pp 538-545 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The possibility of CP asymmetries in decays of W and Z bosons is examined. The asymmetries studied are the differences in the branching ratios of charge conjugate modes such as $W^+ \rightarrow tb$ vs $W^- \rightarrow tb$ or $Z \rightarrow bs$ vs. $Z \rightarrow bs$. In the standard model (SM), with three generations, such effects are found to be vanishingly small. They also discuss the situation in the SM with four generations and in some other models of CP nonconservation. In some versions of the SM with four generations rates for the flavor changing decays of Z's such as $Z \rightarrow b'$anti b appear promising but the measurability of the CP asymmetry appears to be very difficult. This talk is based on work done in collaboration with Nilendra Deshpande, Gad Eilam, and George Hou. 23 references, 2 figures, 2 tables.

2279 **High-p/sub T/ single photon and jet production at Fermilab energies.** Oh, B.Y. (Pennsylvania State Univ., University Park). pp 546-551 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The production of direct photons in events having gluon participation is attractive experimentally because of the constraints imposed on the gluon distribution in the lowest order α_s/ approximation. The expected number and distribution of high -p/sub T/ photons is presented for pp and =p interactions at $\sqrt{s}$ 40 GeV and 32 GeV respectively.

2280 **Possible signatures of isolated hard photons at hadron colliders.** Mikamo, S.; Takaiwa, Y.; Yamashita, A. (Fermilab, Batavia, IL). pp 552-562 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors have pursued the possible signatures of isolated hard photons produced in hadron collisions at energies of the Tevatron and SSC. Special attention is paid to a possible photon source in an alternative SUSY phenomenology. They find that the signature of photons from the photino decay can be observed over the possible backgrounds at the energy of SSC with integrated luminosity above 10^{39} cm^{-2}. 14 references, 15 figures, 1 table.

2281 **Production of heavy fermions.** Willenbrock, S.S.D. (Univ. of Texas, Austin). pp 563-570 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors discuss the production of heavy leptons and quarks in high-energy hadron (pp or anti pp) collisions. They show that heavy lepton pair production occurs principally via gluon fusion rather than the usual Drell-Yan process for leptons heavier than 100-200 GeV in 40 TeV collisions. Heavy quarks, which are pair produced via the strong interaction, may also be produced via W-gluon fusion. W-gluon fusion is an important source of the heavier member of an SU(2)/sub L/ doublet of quarks if the mass splitting within the doublet is large. 10 references, 7 figures.

2282 **Detection of top-quarks at LEP and SLC.** Atwood, D.; Contogouris, A.P.; Tanaka, H. (McGill Univ., Montreal). pp 571-579 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Top-quark t production via $e^-e^+ \rightarrow t$ anti t with one of t, anti t decaying semileptonically and the other decaying into jets is considered at LEP and SLC. It is shown that, with proper procedures involving a series of acceptance cuts, top-quarks with masses m/sub t/ ≦ 70 Gev can be identified. 6 references, 4 figures.

2283 **Physics capabilities at LEP II.** Zeppenfeld, D. (DESY, Hamburg, West Germany). pp 580-600 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The physics interest in high energy e^+e^- collisions at LEP II is reviewed. Special emphasis is given to the extraction of a maximum amount of information from W pair production. Higgs searches at LEP and possible signals for the compositeness of quarks and leptons are discussed as well. 16 references, 18 figures.

2284 **Parton distribution functions incorporating heavy quark mass effects.** Tung, W. (Illinois Institute of Technology, Chicago). pp 601-613 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors describe a theoretically consistent and practically simple renormalization scheme to calculate parton distribution functions in perturbative QCD incorporating heavy quark mass effects. Results obtained with existing parton parametrizations as low energy input are presented. The heavy quark content of proton and anti-proton are found to be larger by at least a factor of 2 in the small x region than previously thought. To help studying high energy processes using properly evolved parton distribution functions, many new sets of PDFs based on existing parametrizations and assumed top quark masses have been generated for general use. In addition, an efficient program to calculate QCD-evolved PDFs with arbitrary input parameters and initial distribution functions is provided. 8 references, 11 figures.

2285 **Probing the tri-boson coupling in high energy vector-boson pair production and the factorization of helicity amplitudes.** Olness, F.; Tung, W. (Illinois Institute of Technology, Chicago). pp 614-631 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract FG02-85ER40235.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors present a method for probing the effects of the tri-boson gauge coupling in order to test the standard model and to discover new physics. It utilizes the natural factorization of helicity amplitudes of tree diagrams. For vector-boson pair-production in fermion-anti-fermion annihilation, they define an approximate helicity basis which confine the contributions of the t-channel fermion exchange process (with known couplings) to a limited set of helicity amplitudes with simple behavior. The remaining amplitudes depend entirely on the s-channel vector-boson exchange process with the associated tri-boson coupling. Angular correlation coefficients and asymmetry parameters in this helicity basis are more directly linked to the tri-boson couplings than in the conventional formalism. 13 references, 4 figures.

2286 **Comments on minijets.** Kim, C.S.; Cudell, J.R.; Halzen, F. (Univ. of Wisconsin, Madison). pp 632-641 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

When the collision energy of two hadrons increases the physics of an increasing fraction of minimum bias events is dictated by perturbative QCD. Gaisser, Pancheri and their collaborators have proposed that the minijets observed by UA1 signal the onset of this phenomenon. Whether minijets are responsible for the rise of the total cross sections is an unrelated issue. Their suggestion is much more radical, namely that all non-scaling features of minimum bias events are related to hard scattering and calculable in perturbation theory. These include the rise of the rapidity plateau in the central region, the increase of <p/sub T/>, the appearance of a high multiplicity tail in the KNO distribution and the correlation between multiplicity and transverse momentum. They comment on the possibility of implementing this idea in a quantitative way avoiding the use of an unphysical minimum P/sub T/ cutoff routinely appearing in the present calculation. 12 references, 3 figures, 1 table.

2287 **Super solenoid a detector for the SSC.** Cihangir, S.; Kazimi, R.; McIntyre, P. (Texas A & M Univ., College Station). pp 642-654 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—).

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

This paper examines some physics consequences of a super solenoid detector which eliminates the charged particles with P/sub t/ less than 0.5 GeV/c. Results indicate a significant reduction in charged particle multiplicity, and consequence improvement of triggering, pattern recognition and data logging. The feasibility of doing physics in the SSC environment with such a detector is discussed.

2288 **ISAJET 5.20: A Monte Carlo event generator for pp and pp-bar interactions.** Paige, F.E.; Protopopescu, S.D. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). pp 213-227 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—).

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

ISAJET is a Monte Carlo program which simulates pp and p-barp interactions at high energy. It is based on perturbative QCD cross sections, leading order QCD radiative corrections for initial and final state partons, and phenomenological models for jet and beam jet fragmentation. This article describes ISAJET 5.20, which includes a new model for beam jets in hard interactions.

2289 **Minijets and Regge theory.** Collins, J.C. (Dept. of Physics, Illinois Institute of Technology, Chicago, IL 60616). pp 15-26 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—).

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

The behavior of parton distributions at small x probes the connection between Regge theory and perturbative QCD. The author considers the restrictions on this behavior that follow from positivity of the distributions and of the kernel of their evolution equation. The distributions should be steeper than the 1/x that follows from Pomeron dominance, by a substantial power of x. A 1/ x/sup 1.5/ behavior would be suitable. The consequences of this are summarized, particularly for "minijet" production at the SppbarS and Tevatron, and for production of systems of up to hundreds of GeV mass at the SSC.

2290 **Diffractive hard scattering and the SSC.** Soper, D.E.; Berger, E.L.; Collins, J.C.; Sterman, G. (High Energy Physics Div., Argonne National Lab., Argonne, IL 60439). pp 3-14 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—). Contract W-31-109-ENG-38;FG06-85ER40224.

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

The authors discuss events in high energy hadron collisions that contain a hard scattering, in the sense that very heavy quarks or high P/sub T/ jets are produced, yet are diffractive, in the sense that one of the incident hadrons is scattered with only a small energy loss.

2291 **A new model for coherent final state parton showers.** Gottschalk, T.D. (California Institute of Technology, Pasadena, CA 91125). pp 122-138 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—).

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

A Monte Carlo model for the generation of coherent final state parton showers is presented. The energy dependence of gluon multiplicities is shown to agree with theoretical expectations. The effects of coherence on hadronic multiplicities and energy distributions in high energy jets are examined.

2292 **(Nearly) model independent description of the spin-dependent interactions in quarkonium.** Schnitzer, H.J. (Brandeis University, Waltham, MA 02254). *AIP (American Institute of Physics) Conference Proceedings;* **132**: No. 1, 404-410(30 Jun 1985). (CONF-8504133—).

From International conference on hadron spectroscopy; College Park, MD, USA (20 Apr 1985).

An effective Hamiltonian for the spin-dependent interactions in quarkonium is defined. The relevant effective interactions are extracted from the data in a nearly model independent way, without reference to specific models. The systematic behavior of the spin-dependent qq-bar interactions is noted.

2293 **Monopoles and the meaning of mica.** Kolb, E.; Seckel, D.; Vega, R. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 474-475 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The authors discuss the implications of the recent search for magnetic monopoles conducted previously. The experiment is sensitive to a monopole flux smaller than the Parker bound. However, there are several ways in which this conclusion may be modified. The most important is that monopole-proton bound states may form in the early universe. Monopoles which have protons attached upon entering the Earth's crust would not be detected.

2294 **Monte Carlo studies of high transverse energy hadronic interactions.** Corcoran, M.D. (Rice Univ.). pp 525 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A four jet Monte Carlo based on the Feynman-Field model has been used to simulate hadronic interactions which deposit high transverse energy into a large solid angle calorimeter. It is found that the Monte Carlo results are particularly sensitive to the method used to ensure overall energy conservation, to the minimum vertical bar tarc vertical bar of the QCD subprocess, and to the p/sub T/ with respect to the jet axis used in the fragmentation. With reasonable choices of these features of the Monte Carlo, good agreement with data at Fermilab energies is obtained. With other choices the Monte Carlo gives very different results which are in strong disagreement with the data.

2295 **Study of gluon bremstrahlung effects in hadron-hadron collisions at $\sqrt{s}$=27.** Johns, K.A. (Rice Univ.). pp 525 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Using a full azimuthal, large solid angle, segmented calorimeter the author has studied the production of high transverse momentum jets from pp collisions at $\sqrt{s}$=27 at FNAL. With two different types of geometrically unbiased triggers, a detailed comparison (cross sections, energy flows, jet parameter distributions, etc.) is made between the experimental data and a QCD Monte Carlo including both initial and final state gluon radiation. The production and characteristics of three jet events in both the data and Monte Carlo are discussed.

2296 **Qualitative features of the glueball spectrum.** Jaffe, R.L.; Johnson, K.; Ryzak, Z. Cambridge, MA; Massachusetts Institute of Technology (1985). 25p. Contract AC02-76ER03069.

The low energy meson spectrum is investigated. Quantum numbers of the lightest glueballs are obtained by studying low dimension, gauge invariant, colorless operators. A general shell model of hadrons is formulated and its predictions are specified. A comparison and criticism of existing glueball models is included. 18 references, 3 figures, 7 tables.

2297 **Particle production in the central rapidity region of ultrarelativistic nuclear collisions.** Kerman, A.K.; Matsui, T.; Svetitsky, B. Cambridge, MA; Massachusetts Institute of Technology (1985). 7p. Contract AC02-76ER03069.

The authors discuss the central rapidity region of high energy proton-nucleus collisions in the context of a flux tube model. This model supposes the creation of a color flux tube by a random walk color charging process and its subsequent decay by q anti q and gluon pair creation. The observed dependence of particle multiplicity on the number nu of projectile interactions is explained. Some further implications of the model for high energy proton-nucleus and nucleus-nucleus collisions, including A-dependence in the latter case, are discussed. 15 references, 1 figure.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 2130, 2213, 2254, 2275, 2279, 2280, 2315, 2323, 2327, 2329

2298 **(INS—625) Monte Carlo study of the virial theorem in quantum mechanics and finite temperature lattice gauge model.** Kimura, N.; Sogo, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750067/JAW.

Path integral formalism is developed for quantum mechanics and finite temperature U(1) gauge model. Internal energy formula and virial theorem are derived and compared satisfactorily with the result from Monte Carlo simulations.

2299 **(NORDITA—87/25-P-Prepr.) Modular invariance in N=2 superconformal field theories.** Ravanini, F.; Yang, S.K. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). May 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750031/JAW.

The modular invariance properties of two-dimensional N=2 superconformal field theories are studied. It is shown that the character formulae of the central charge C<3 unitary highest weight representation for the untwisted algebras can be written in terms of the string functions and the theta functions of the affine su(2) Kac-Moody algebra. Deriving the modular transformation of the characters we construct the modular invariant partition functions on a torus. The character relation corresponding to the coset space construction of the unitary discrete series in the N=2 algebra is also obtained.

2300 **Penguin matrix elements in chiral perturbation theory and in vacuum insertion.** Cheng, H. (Physics Department, Indiana University, Bloomington, Indiana 47405). *Physical Review [Section] D: Particles and Fields;* **36**: No. 7, 2056-2059(1 Oct 1987).

The momentum dependence of the matrix elements of quark bilinear scalar and pseudoscalar densities is determined from chiral perturbation theory. We explain why the original vacuum-insertion calculation of the penguin-induced K^0-2π amplitude by Shifman, Vainshtein, and Zakharov (SVZ) gives the correct chiral result even though only the momentum dependence in <$\pi\pi$chemical bondd-bardchemical bond0> is taken into consideration in the SVZ work.

2301 **Search for supersymmetry at the tevatron and SSC.** Barnett, R.M.; Haber, H.E. (Univ. of California, Berkeley). pp 442-452 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract AC03-76SF00098.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

The authors review the work and conclusions from Snowmass '84, and the progress in the intervening two years. The impact

of the analysis of the UA1 data is discussed. They discuss new work relevant to the search for supersymmetry at the Tevatron and SSC. Special attention is given to the emergence of trijets as a signal at the Tevatron. The backgrounds for this signal are examined. 8 references, 6 figures.

6454 Field Theory

REFER ALSO TO CITATION(S) 2142, 2164, 2242, 2244, 2249, 2250, 2251, 2252, 2253, 2254, 2257, 2258, 2261, 2262, 2263, 2264, 2265, 2269, 2270, 2272, 2273, 2275, 2279, 2280, 2281, 2286

2302 **(BONN-HE—87-09) D=2 conformally invariant SU(2) σ-model with Wess-Zumino term and related critical theories.** Flume, R. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). May 1987. 10p. (CONF-8702107—1). NTIS, PC E07; NTIS as TIB/B87-11460.

From Workshop on renormalization of quantum field theories with non-linear field transformations; Schloss Ringberg, F.R. Germany (16 Feb 1987).

The structure of the four point correlation functions of the conformally invariant SU(2) σi model is presented. Relations of the SU(2) model to other critical theories are pointed out.

2303 **(CERN-EP—87-92) The search for gluonic matter.** Palano, A. (European Organization for Nuclear Research, Geneva (Switzerland); Bari Univ. (Italy). Dipartimento di Fisica). 18 May 1987. 36p. (CONF-870339—4). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900055/JAW.

From Moriond meeting on hadrons, quarks and gluons; Les Arcs, France (15 Mar 1987).

The experimental status of the search for new states coupled to gluons is reviewed. A critical analysis of the experimental information reveals a large activity in the field with new particles, never seen before, emerging from the gluonium laboratories. The experimental situation is, however, rather confused and no particle has been, up to now, established as a gluonium state. 79 refs.

2304 (CONF-8605182—, pp 25-41) **Finite-element approximation in quantum field theory.** Bender, C.M. (Washington Univ., St. Louis, MO). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

In this talk the author describes a research program that has been underway for several years. The objective is to find a fast and accurate scheme for solving quantum field theory on a lattice which does not involve a Monte Carlo algorithm. They use an alternative strategy based on the method of finite elements. They are able to formulate fully consistent quantum-mechanical systems directly on a lattice in terms of operator difference equations. One of the many advantages of doing this is that the fermion doubling problem is completely eliminated. The method for solving operator difference equations is discussed for various elementary quantum-mechanical and field-theoretic models including the Schwinger and Sine-Gordon models. Good numerical results are obtained.

2305 (CONF-8605182—, pp 273-297) **Strings in spring (86).** Ramond, P. (Univ. of Florida, Gainesville). 1986. NTIS, PC A15/MF A01. Order Number DE87012199/JAW. Contract FG05-86ER40272.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

The authors present an overview of recent progress in string theory. They treat in detail the mechanics of some of the Calabi-Yau compactification and summarize some of its experimental consequences.

2306 **(DOE/ER/40200—117) Gravity from symmetry breakdown of a gauge affine theory.** Ne'eman, Y.; Sijacki, D. (Texas Univ., Austin (USA). Center for Particle Theory; Tel Aviv Univ. (Israel). Sackler Faculty of Exact Sciences; Belgrade Univ. (Yugoslavia). Inst. za Fiziku). Sep 1987. Contract FG05-85ER40200. 26p. (TAUP/N—183/87). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001671/JAW.

We construct a gauge field theory based on bar GA(4,R) space-time symmetry, and provide the full Lagrangian containing spinorial and tensorial (infinite-component) matter manifields. We break the dilation symmetry and thus trigger a spontaneous breaking of the bar SL(4,R)/bar SO(1,3), also generating Newton's constant. The resulting space-time is of Riemann-Cartan type and in the flat limit we recover Special Relativity.

2307 **(DOE/ER/40200—118) A supersymmetric Lagrangian for Poincare gauge theories of gravity.** Castro, C. (Texas Univ., Austin (USA). Center for Particle Theory). Oct 1987. Contract FG05-85ER40200. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001670/JAW.

A supersymmetric construction of the most general quadratic field Lagrangian for Poincare Gauge Field Theories of gravity, recently proposed by Kuhfuss-Nitsch to be devoid of ghosts and tachyons, is presented.

2308 (INIS-SU—422, pp 32-35) **On a realization of the exceptional algebras E/sub 6/ and E/sub 8/.** Nguen Van Kh'yu; Nguen Khung Shon. 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780010/JAW. (JINR-N—17-86).

In JINR rapid communications. Collection.

The exceptional Lie algebras E/sub 6/ and E/sub 8/ are realized in terms of the covariant operators transformed as scalars, spinors, vectors and an antisymmetric tensor under the subalgebra SO(10). All commutation relations are given explicitly. 3 refs.

2309 **(ITFA—86-24) Pseudoscalar masses and index theorem.** Smit, J.; Vink, J.C. (Amsterdam Univ. (Netherlands). Inst. voor Theoretische Fysica). 1986. 9p. (CONF-8609142—9). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900034/JAW.

From Lattice gauge theory meeting; Upton, NY, USA (15 Sep 1986).

A lattice derivation for the neutral pseudoscalar masses in lattice quantum chromodynamics (QCD) leads to a formula for the topological susceptibility through the fermion fields, in which the gauge field topological charge is recovered via the Atiyah-Singer index theorem. A numerical study in two dimensional QED gives insight into corrections due to a non-zero lattice distance. 15 refs.

2310 **(NBI-HE—87-19) Anomalous fermion number nonconservation at high temperatures: Two dimensional example.** Bochkarev, A.I.; Shaposhnikov, M.E. (Niels Bohr Inst., Copenhagen (Denmark); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Apr 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750034/JAW.

We consider γ/sub 5/ version of Abelian Higgs model in 1+1 dimensions and find one loop expression for the rate of fermion number non-conservation at high temperatures. We discuss the construction of the noncontractible loop in the configuration space and an analog of the sphaleron solution in the theory.

2311 **(NBI-HE—87-20) Free energy of higher representation sources in lattice gauge theories.** Damgaard, P.H. (Niels Bohr Inst., Copenhagen (Denmark)). Apr 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750029/JAW.

Deconfinement of higher representation sources in SU(2) lattice gauge theory is studied by a Monte Carlo simulation on an 8/sup 3/.x 2 lattice. Results for the free energy are compared with expectations from the effective theory of thermal Polyakov loops, and critical exponents for the magnetization of different representations in SU(2) are computed. We also compare the predictions for higher representations in SU(3) lattice gauge theory with some recent Monte Carlo data. Finally, possible phenomenological consequences of the deconfinement associated with higher representation sources are discussed.

2312 **(RAL—87-013) Resolution of the U(1) problem by lattice gauge theory.** Hoek, J. (Rutherford Appleton Lab., Chilton (UK)). Mar 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752946/JAW.

The paper examines the solution of the U(1) problem by lattice gauge theory. An approximation is discussed which makes the problem accessible to calculations in pure gauge theory, without dynamical fermions. Results of SU(3) lattice calculations are reviewed, and the results are presented as the resolution of the U(1) problem.

2313 **(SLAC—317) Family number non-conservation induced by the supersymmetric mixing of scalar leptons.** Levine, M.J.S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Aug 1987. Contract AC03-76SF00515. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88001330/JAW.

The most egregious aspect of (N = 1) supersymmetric theories is that each particle state is accompanied by a 'super-partner', a state with identical quantum numbers save that it differs in spin by one half unit. For the leptons these are scalars and are called "sleptons", or scalar leptons. These consist of the charged sleptons (selectron, smuon, stau) and the scalar neutrinos ('sneutrinos'). We examine a model of supersymmetry with soft breaking terms in the electroweak sector. Explicit mixing among the scalar leptons results in a number of effects, principally non-conservation of lepton family number. Comparison with experiment permits us to place constraints upon the model. 49 refs., 12 figs.

2314 **(VPI-HEP—86/9) Duality transformations and Kaehler geometry in supersymmetric theories.** Mahanthappa, K.T.; Staebler, G.M. (Colorado Univ., Boulder (USA). Dept. of Physics; Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Physics). 1986. Contract AS05-80ER10713. 8p. (CONF-860701—88). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000555/JAW.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The duality transformation between different off-shell representations of the scalar supermultiplet is shown to not always be invertible. The geometry of the supersymmetric non-linear σ-model in 3+1 dimensions is not necessarily Kaehler, even on-shell, when the duality transformation fails. 6 refs.

2315 **(VPI-HEP—87/3) Note on uniqueness of the standard color-flavor gauge group.** Marshak, R.E. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Physics). Jul 1987. Contract AS05-80ER10713. 10p. (CONF-870797—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000556/JAW.

From International symposium for lepton and photon interactions at high energy; Hamburg, F.R. Germany (27 Jul 1987).

The "theoretical" arguments for the uniqueness of the standard color-flavor gauge group are reexamined. It is pointed out that SU(3) is the only "color" group that is consistent with the Pauli principle for three-quark flavor systems (baryons) and does not permit fractionally charged unconfined quark-gluon objects. A new argument is produced for the left-right-symmetric electroweak group SU(2)/sub L/ x SU(2)/sub R/ x U(1)/sub S - L/ being the maximal gauged chiral flavor subgroup of the global chiral quark flavor group SU(n)/sub L/ x SU(n)/sub R/ x U(1)/sub L + R/ for n flavors of massless quarks. This explains the generational grouping in quark and lepton chiral doublets and encourages increased efforts to find the new physics in the LRS electroweak group. 8 refs.

2316 **Self-dual fields as charge-density solitons.** Floreanini, R.; Jackiw, R. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review Letters;* **59**: No. 17, 1873-1876(26 Oct 1987).

Two-dimensional Poincarean-invariant self-dual fields are consistently quantized. A fermionic formulation is shown to be equivalent to a nonlocal bosonic one. Self-dual boson fields are solitons describing a charge-density wave of paired fermions.

2317 **Hadronic screening lengths in the high-temperature plasma.** Gottlieb, S.; Liu, W.; Toussaint, D.; Renken, R.L.; Sugar, R.L. (Department of Physics, Indiana University, Bloomington, Indiana 47405). *Physical Review Letters;* **59**: No. 17, 1881-1884(26 Oct 1987).

Using a hybrid molecular-dynamics simulation of lattice QCD we measure the spatial screening lengths of local meson and baryon operators with two flavors of Kogut-Susskind fermions. In the high-temperature phase the meson and nucleon screening lengths are parity doubled and their inverses are comparable to the zero-temperature masses. We construct chiral projections for the meson and nucleon propagators which demonstrate the chiral symmetry in a way independent of the extraction of masses from the propagators.

2318 **Comment on "What is the most general Abelian gauge theory in two spatial dimensions?".** Deser, S.; Jackiw, R. (Department of Physics, Brandeis University, Waltham, Masschusetts 02254). *Physical Review Letters;* **59**: No. 17, 1981-1981(26 Oct 1987).

A Comment on the Letter by C. R. Hagen, Phys. Rev. Lett. 58, 1074 (1987).

2319 **Hagen replies.** Hagen, C.R. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review Letters;* **59**: No. 17, 1982-1982(26 Oct 1987).

The author replies to comments on his recent paper on abelian gauge theory. (AIP)

2320 **Derivative expansion and the solubility of two-dimensional models.** Das, A.; Karev, A. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review [Section] D: Particles and Fields;* **36**: No. 8, 2591-2594(15 Oct 1987).

We apply the method of the derivative expansion to solve for simple two-dimensional models. We obtain the one-parameter class of solutions for the massless Thirring model, the massive-vector-boson model, and the gradient-coupling model. The solution for the Schwinger model is obtained in a limit of the massive-vector-boson model.

2321 **Estimating the chiral-symmetry—restoration temperature in two-flavor QCD.** Gottlieb, S.; Liu, W.; Toussaint, D.; Renken, R.L.; Sugar, R.L. (Department of Physics, Indiana University, Bloomington, Indiana 47401). *Physical Review Letters;* **59**: No. 14, 1513-1516(5 Oct 1987).

We combine measurements of the chiral-symmetry—restoration transition temperature and hadron masses in lattice QCD with two flavors of light quarks to estimate the transition temperature in megaelectronvolts. We compare this estimate to results of "quenched" QCD to estimate the effects of our large lattice spacing on the results. We find that the dynamical quarks lower the temperature of the phase transition relative to the pure gauge theory.

2322 **Gauge covariant linear response analysis of QCD plasma oscillations.** Heinz, U.; Kajantie, K.; Toimela, T. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Annals of Physics (New York);* **176**: No. 2, 218-277(Jun 1987). Contract AC02-76CH00016.

We show, using linear response theory, how plasma oscillations and screening in quark—gluon plasma can be computed in perturbation theory in a gauge covariant number. Using this method we calculate the damping constant of color electric plasma oscillations in a Coulomb gauge and show that the result agrees with an earlier calculation in the $A_0 = 0$ gauge.

2323 **D = 4 NO scale supergravities from D = 10 superstrings.** Kounnas, C. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 390-393 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Dimensional reductions of supergravity theories are shown to yield to specific classes of four dimensional no scale models with N=4, 2 or 1 residual supersymmetry. N=1 "maximal" supergravity lagrangrian, corresponding to the "untwisted" sector of orbifold

compactification of superstrings, contains nine families and has a no scale structure based on the Kahler manifold. The quantum consistency of the resulting theories give informations on the non Kaluza-Klein (string) "twisted" sector.

2324 **Semi-hard processes and QCD.** Collins, J.C. (Illinois Institute of Technology, Chicago). pp 265-277 of Physics simulations at high energy. Barger, V.; Gottschalk, T.; Halzen, F. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). (DOE/ER/40278—1; CONF-8605163—). Contract FG02-85ER40235.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Semi-hard processes in QCD are parton subprocesses involving virtualities Q that are at the same time in the perturbative region ($Q >> \Lambda/\text{sub QCD/}$) and much smaller than the total center-of-mass energy ($Q << \sqrt{s}$). These often have a power-law growth with $\sqrt{s}$. The author summarizes some of their important properties, concentrating on minijet production at collider energies. 13 references, 8 figures.

2325 **The gluon is massive: Results of a lattice Monte Carlo calculation in the Landau gauge.** Mandula, J.E.; Ogilvie, M. (U.S. Dept. of Energy, Washington, DC 20545). pp 27-37 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—).

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

A Monte Carlo calculation of the gluon propagator in the Landau gauge in SU(3) lattice gauge theory is described. Gribov ambiguities are briefly discussed. The results of calculations at $\beta =$ 5.6 (200 4/sup 3/ x 8 lattices), $\beta = 5.8$ (400 4/sup 3/ x 10 lattices), and $\beta = 6.0$ (100 4/sup 3/ x 8 lattices) indicate that the gluon propagator resembles a massive particle propagator with asymptotic mass near 600 MeV. Theoretical and phenomenological implications of these results are discussed, as is the interpretation of the mass in the propagator as a constituent gluon mass.

2326 **Topics in perturbative QCD at collider energies.** Ellis, R.K. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 167-182 of Observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities. Bengtsson, H.U.; Buchanan, C.; Gottschalk, T.; Soni, A. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-860168—).

From Workshop on observable standard model physics at the SSC: Monte Carlo simulation and detector capabilities; Los Angeles, CA, USA (15 Jan 1986).

Three topics in perturbative QCD of relevance at collider energies are reviewed. They are: colour coherence and Monte-Carlo programs; the hadronic production of heavy flavours; two jet events and calorimetric cross-sections.

2327 **Spontaneous supersymmetry breaking in supergravity without matter fields.** Staebler, G.M. (VPI). pp 478 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

The properties of spontaneous supersymmetry breaking by the auxiliary fields in supergravity theories are discussed. It is shown that there is no propagating Goldstone spinor and that only the off-shell degrees of freedom are conserved. These results are found not to be in conflict with the supersymmetric extension of Goldstones theorem.

2328 **Isometries and dimensional reduction.** Witten, L.; Mansouri, F. (Univ. of Cincinnati). pp 478 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A dimensional reduction has been carried out for multidimensional (d+n) space times which have non-abelian isometries. The Killing vectors span an n dimensional space. The dimensional reduction is carried out in a way that removes all traces of the extra dimensions from the reduced theory while ensuring that the solutions to the reduced theory are also solutions of the initial higher dimensional theory. The theory thus appears as a strictly d(usually d=4) dimensional theory. Some remarks are made on symmetries in the reduced theory for simple special cases.

2329 **Off-shell representations of maximally-extended supersymmetry.** Cox, P.H. (Univ. of Alabama). pp 478 of Proceedings of the Santa Fe meeting of the Division of Particles and Fields of the American Physical Society. Goldman, T.; Nieto, M.M. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8410222—).

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

A general theorem on the necessity of off-shell central charges in representations of maximally-extended supersymmetry (number of spinor charges - 4 x largest spin) is presented. A procedure for building larger and higher-N representations is also explored; a (noninteracting) N=8, maximum spin 2, off-shell representation is achieved. Difficulties in adding interactions for this representation are discussed.

2330 **Wave functions and finite size effects in a two-dimensional lattice field theory.** Thacker, H.B. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 92-104 of Advances in lattice gauge theory. Duke, D.W.; Owens, J.F. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8504167—).

From Conference on advances in lattice gauge theory; Coral Gables, FL, USA (10 Apr 1985).

A study of finite size corrections to the masses of fermions and bound states in the Baxter/massive Thirring/sine Gordon lattice field theory is discussed. It is shown that information on bound state wave functions may be used to extrapolate Monte Carlo mass calculations to infinite volume.

65 PHYSICS II

2331 **(CEA-CONF—8878) Review of the study of the reactions A(N,π)A+1.** Couvert, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Nov 1986. 18p. (In French). (CEA-DPH-N-S—2414; CONF-8611138—10). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752920/JAW.

From Saturne workshop; La Londe-les-Maures, France (10 Nov 1986).

Fifteen years of studies of the exclusive reactions (N,π) have brought many hopes and more disappointments. This paper presents a critical review to point out the relevant progress achieved in the theoretical and experimental fields. A special attention is paid to a systematic phenomenological study of the experimental results of the reaction (p,π^+) on some nuclei pointing out some aspects of the reaction mechanism. 24 references.

2332 **(CNEA-NT—10/86) Progress report 1984-1985. Department of Physics.** (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Fisica). Apr 1986. 140p. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700108/JAW.

Spanish version of CNEA-NT--11/86. Abstract included in English version .

The Department of Physics of the National Atomic Energy Commission reports on the advances and achievements performed during 1984-1985 within its three divisions: (1) Tandar Project; (2) Nuclear Physics (Nuclear Structure, Nuclear Reactions Intermediate Energies) and (3) Solid State Physics (Vibrational Spectroscopy, Cristallography and Phase transitions, Moessbauer Spectroscopy, Theoretical Solid State Physics, Crystal growth). Finally, a list

of publications made by the personnel during said period, is included. (M.E.L.).

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 954, 2143, 2144, 2169

2333 **(CSNSM-RA—1984) [Report of activities at Salomon Rosenblum and Rene Bernas]. Progress report 1983-1984.** (Paris-11 Univ., 91 - Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). 1985. 228p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE87752712/JAW.

This report presents the studies of the laboratories of nuclear spectrometry Salomon Rosenblum (LNSSR) and of mass spectrometry Rene Bernas (LMSRB). The main axis of research of the LNSSR is the study of the nuclear structure in very different excitation conditions. Studies of reaction mechanisms (lifetime for particle emission) allowed to point out new atomic collision processes strongly correlated with the nuclear interaction. The laboratory has also studied the atomic effects related to the rearrangement of the electron cloud disturbed by nuclear decays. An experiment program concerns the study of low-energy nuclear reaction. The studies of the LMSRB are developed by five sections in the following fields: nuclear physics, mass spectrometry, theoretical astrophysics, geophysics and astrophysics, solid physics, isotope separation and implantation. The studies deal more particularly with exotic nuclei, the proton and antiproton mass comparison, works developed with the Tandetron (/sup 10/Be abundance variation, climate periods and magnetic field inversion correlation), calculations of nucleosynthesis, effects of implantation in metals, microanalysis of insulating samples of both terrestrial and extraterrestrial origin.

2334 **(DOE/ER/10638—8) Nuclear structure studies using the high resolution spectrometer at the Los Alamos Clinton P. Anderson Meson Physics Facility: Annual progress report, [1987-1988].** (Texas Univ., Austin (USA). Dept. of Physics). Sep 1987. Contract AS05-80ER10638. 175p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001476/JAW.

This document constitutes the (1987 to 1988) progress report for the ongoing medium energy nuclear physics research program supported by the US Department of Energy with the University of Texas at Austin. A major part of the work has been and will continue to be associated with research done at the Los Alamos Clinton P. Anderson Meson Physics Facility (LAMPF) using the High Resolution Spectrometer (HRS), the External Proton Beam (EPB), and the new Neutron Time of Flight Facility (NTOF). Other research is done at the Fermi National Accelerator Laboratory (FNAL). The research focuses on (1) providing proton + nucleus data which test nonrelativistic and relativistic models of the medium energy proton + nucleus interaction, (2) providing (p,p) and (p,n) data which are to be analyzed to provide new nuclear structure information (both ground state and excited state), (3) providing nucleon + nucleon data to aid in the systematic study of the fundamental nucleon-nucleon interaction, (4) developing and improving the proton + nucleus theoretical models themselves, and (5) initiating new experimental programs whose goals are to search for new phenomena in nuclear physics. 182 refs., 71 figs., 5 tabs.

2335 **(DOE/ER/40285—2) A program in medium-energy nuclear physics: Technical progress report, September 1986-August 1987.** Berman, B.L. (George Washington Univ., Washington, DC (USA)). 1987. Contract FG05-86ER40285. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001471/JAW.

A short summary is given of the research program in nuclear physics. The report is organized into sections on experiments, data analysis, proposals, the GWU Nuclear Detector Laboratory, and the Three-Body Symposium. (DWL)

2336 **(GANIL-P—86-17) Study of properties of nuclei far from stability at GANIL.** Mueller, A.C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Jul 1986. 8p. (CONF-860741—25). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752696/JAW.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

The favourable production conditions for light exotic nuclei at GANIL led to the start of several experimental programs which are briefly sketched. First promising results have been obtained already. This may justify optimism for the future, especially in view of the upgrading of GANIL which is planned as well for the energy as well as for the intensity of the beams.

2337 **(INIS-BR—722) Fission of intermediate mass nuclei by photons of stopping radiation in the maximum energy range 0.8 - 1.8 MeV.** Lima, D.A. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Jul 1983. 133p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703474/JAW.

The fission of intermediate mass nuclei in Al - Ta interval, induced by stopping radiation phtons of maximum energies between 0.8 and 1.8 GeV is studied. Nd and Sm thin targets and Al, Ti, Co, Zr, Nb, Ag, In and Ta thick targets were used, considering all peculiarities inherent to absorption of fission fragments in the target. The samples were exposed into the 2.5 GeV Electron Synchrotron in Bonn Univerity. The fission fragment tracks were registered in foil type detectors using mica muscovite for Sm and Nd, CR-39 for Al and Ti and makrofol for Co, Zr; Nb, Ag, In, Nd and Ta. The track length and track depth angle distributions were measured for determining fission efficiencies. The fission cross sections and nuclear fissionable of the studied elements were evaluated. (M.C.K.).

2338 (INIS-SU—414, pp 25-33) **Study of secondary nuclei produced on the synchrophasotron internal target at the ANOMALON facility.** Golutvin, I.A.; Dolya, S.N.; Zhil'tsov, V.E. 1986. (In Russian). NTIS (US Sales Only), PC Axx/MF A01. Order Number DE88780009/JAW. (JINR-N—15-86).

In JINR rapid communications. Collection.

The results of experiments on a slow extraction of /sup 12/B, /sup 14/C, /sup 16/N a.o. fragments of parental nucleus of fluorine (/sup 19/F) from the synchrophasotron inner target along the channel are presented. The upper limit of fragment yield with fractional charge (Z=7.7) and /sup 19/F -> /sup 19/O charge exchange cross sections are estimated. The momentum distributions of fragments are presented. /sup 19/F primary nucleus momentum is 4 GeV/nucl.xc. 10 refs.; 5 figs.; 1 tab.

2339 (INIS-SU—422, pp 13-18) **Measurement of cross sections of the /sup 19/F nuclear interaction at 4 GeV/c per nucleon.** Golovin, V.M.; Golutvin, I.A.; Dolya, S.N. 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780010/JAW. (JINR-N—17-86).

In JINR rapid communications. Collection.

The A dependence of the /sup 19/F charge-changing cross section at 4 GeV/c x nucleon has been studied on C, Al, Cu, In, W, Bi and U targets. The detection apparatus consisted of a transmission detector, where the trajectory of nuclei on the target input is determined with proportional chambers, and nuclear charge in front and behind the target - by Cherenkov counters. Cross sections measured with 2% accuracy are presented for each target. The dependence of cross sections on atomic target number coincides (except of cross sections for heavy target interaction) with the predicted simple geometric models. 14 refs.; 4 figs.; 1 tab.

2340 **(INIS-SU—424) JINR rpaid communications. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1986. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780011/JAW.

Seperate abstracts were prepared for each paper in this collection. (DWL)

2341 **(LA—11085-MS) Medium-Energy Nuclear Data Library (MENDLIB): Phase 1.** Siciliano, E.R.; Arthur, E.D. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000724/JAW.

This document describes an initial step towards the formation of a computerized on-line data library, which would contain published medium-energy experimental data, and which would serve the basic and applied needs of the medium-energy nuclear physics community. The data emphasized in this project will be from measured charged-particle and meson induced nuclear scattering and reactions; an area for which no such data base presently exists. Access to the data will be through a menu-driven program in a user-friendly environment. The project is divided into three phases: Phase 1 involves compilation of Clinton P. Anderson Meson Physics Facility (LAMPF) data from nucleon and pion induced reactions, Phase 2 includes nucleon and pion data from other medium-energy facilities, and Phase 3 includes electron, light-ion, and possibly kaon and anti-nucleon data. The initial goals, the manner in which they would be pursued, and the resources needed to implement Phase 1 (the pilot phase) are discussed in detail. Possible expansion of Phase 1 to attain the envisioned goals of Phase 2 and 3 are briefly outlined. During all stages of the project, input from the community will be sought via the various facility user groups and the American Physical Society Division of Nuclear Physics. It is proposed that the Applied Nuclear Science Group (T-2) of the Los Alamos National Laboratory oversees the development and implementation of this project, and the LAMPF VAX computers be used as the host computers for on-line access.

2342 **(LYCEN—8501) [Nuclear Physics Institute of Lyon]. 1984. Annual progress report.** (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). 1985. 112p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87752710/JAW.

This report presents the research works developed at the Nuclear Physics Institute of Lyon during the year 1984 in the following fields: theoretical physics, high-energy and intermediate-energy physics, nuclear physics, inter-disciplinary physics, instrumentation. A list of the publications of the year 1984 is finally given.

2343 **(NEANDC(E)—282-Vol.8) UK nuclear data progress report, January-December 1986.** Sene, M.R.; Cookson, J.A. (eds.). (UKAEA Atomic Energy Research Establishment, Harwell. Nuclear Physics Div.). Jun 1987. 101p. (UKNDC—86-P114; INDC(UK)—042/LN). United Kingdom Atomic Energy Authority, Harwell Laboratory, Oxfordshire, OX11 ORA England. Order Number TI88900033/JAW.

This report is prepared at the request of the United Kingdom Nuclear Data Committee (UKNDC) and summarizes nuclear data research in the UK during calendar year 1986. Separate abstracts have been prepared for the individual contributions to this report.

2344 **(p,n) reaction as a probe of beta decay strength.** Taddeucci, T.N.; Goulding, C.A.; Carey, T.A.; Byrd, R.C.; Goodman, C.D.; Gaarde, C.; Larsen, J.; Horen, D.; Rapaport, J.; Sugarbaker, E. (Los Alamos National Lab., NM, USA; Indiana Univ., Bloomington, USA; Niels Bohr Inst., Copenhagen, Denmark; Oak Ridge National Lab., TN, USA; Ohio Univ., Athens, USA; Ohio State Univ., Columbus, USA). *Nuclear Physics [Section] A;* **469**: No. 1, 125-172(20 Jul 1987).

The evidence for a useful proportionality relationship between 0/sup 0/ (p,n) cross sections and the corresponding Gamow-Teller and Fermi beta-decay transition strengths is examined in detail. A simple parameterization for small momentum transfer L=0 transitions is developed and used in the analysis of (p,n) data in the bombarding energy range 120-200 MeV. The parameterization describes the (p,n) differential cross section in terms of momentum transfer, energy loss, mass number, and bombarding energy and provides a straightforward way of extrapolating to zero momentum transfer. It is found that a single proportionality constant can serve to relate all Gamow-Teller transitions originating from the same target nucleus. The target dependence of this proportionality constant, however, is found to be unpredictable at the 20%-50% level, even within isotopic chains. Such large variations cannot be easily explained in the context of the standard single-step direct-reaction distorted-waves impulse approximation model.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 1407

2345 **(CEA-CONF—8879) Collective nuclear excitations.** Bonin, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Nov 1986. 18p. (In French). (CEA-DPH-N-S—2416; CONF-8611138—11). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752921/JAW.

From Saturne workshop; La Londe-les-Maures, France (10 Nov 1986).

This paper reviews the present experimental situation of the study of giant resonances, and discusses the possibilities offered by Saturne plus Mimas in this field. 26 references.

2346 **(IPNO-TH—86-59) Heavy ions collisions and the site-bond percolation.** Desbois, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jul 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752685/JAW.

Site-bond percolation on a lattice is used for the investigation of heavy ions reactions. A model characterized by two parameters, p and q, is worked out and a critical zone in the p-q plane is shown up. Analytical expressions for various quantities concerning percolation and evaporation are established. Calculations of energy spectra, linear momentum transfer, fragment multiplicities and mass yields at various bombarding energies are compared with experimental data. Different possibilities for the attainment of the multifragmentation regime are discussed. 17 figs; 43 refs.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

2347 **(CEA-CONF—8852) High momentum components and many body effects in ^{3}He(ee'p) and ^{3}He(ee') experiments.** Morgenstern, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Oct 1986. 11p. (CEA-DPH-N-S—2397; CONF-8610196—7). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752903/JAW.

From European workshop on few body physics; Rome, Italy (7 Oct 1986).

The proton momentum distribution has been measured at Saclay, up to 600 MeV/c in a new coincidence ^{3}He(ee'p) experiment following a previous measurement up to 300 MeV. Evidence of two-body correlations observed in the ^{3}He(ee'p)pn channel is shown. These results are compared to previous inclusive ^{3}He(ee') performed at SLAC and Saclay.

2348 **(CEA-CONF—8853) Photon and electrodisintegration function of the few-body systems.** Laget, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Oct 1986. 10p. (CEA-DPH-N-S—2395; CONF-8610196—8). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752904/JAW.

From European workshop on few body physics; Rome, Italy (7 Oct 1986).

The present status of the analysis of very inelastic photo and electronuclear reactions is reviewed, with a special emphasis on the ^{3}He(e,e'2p) and ^{3}He(γ,pp)n reactions, which are the best tools to study the two body correlations and the three-body exchange currents.

2349 **(CEA-CONF—8963) Recent studies on the two and three-nucleon from factors.** Martino, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Feb 1987. 7p. (CEA-DPH-N-S—2439; CONF-8702101—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752768/JAW.

From Workshop on intermediate energies: short-range nuclear physics; Orsay, France (11 Feb 1987).

In this report, I shall present the recent experimental results from electron scattering (elastic and threshold break-up) on 2- and 3-nucleon systems. The separation of the charge (timelike) or magnetic (spacelike) and isoscalar or isovector components of the observables will be of greatest help in the necessary global and coherent comparison and description of the A=2 and A=3 systems.

2350 **(CEA-CONF—8964) Narrow dibaryon research: hadronic probe.** Bonin, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie). Feb 1987. 10p. (In French). (CEA-DPH-N-S—2431; CONF-8702101—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752769/JAW.

From Workshop on intermediate energies: short-range nuclear physics; Orsay, France (11 Feb 1987).

A quick review of experiments using hadron beams is presented here. Dibaryons considered are not strange, and experiments presented are mostly from Saturne. The width of the dibaryons is small compared to the delta resonance so that their existence is difficult to interpret in terms of pions.

2351 **(CERN-EP—87-91) A summary of recent antiprotonic atom experiments.** Poth, H. (European Organization for Nuclear Research, Geneva (Switzerland); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). 18 May 1987. 18p. (CONF-870413—15). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900038/JAW.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

The outcome of the measurements on antiprotonic atoms performed in recent years is summarized. The experiments, done at the low-energy antiproton ring (LEAR), mainly studied the strong interaction of antiprotons with nucleons. The principal goals of the investigations were the measurement of level energies and widths in antiprotonic atoms with the aim of getting information on the overall antiproton-nucleus and antiproton-nucleon interactions in general, and the study of the spin and isospin dependence of that force. Moreover, the magnetic moment of the antiproton was determined with a factor of 2 higher precision than previously known. Furthermore, the antiproton absorption was studied in detail. The analysis of the strong-interaction effects in terms of an antiproton-nucleon potential is in progress. 36 refs., 5 figs.

2352 **(FRCEA-TH—25) Measurement of the deuterium structure function A(q/sup 2/) by electron scattering.** Hacene, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie; Paris-6 Univ., 75 (France)). Dec 1986. 116p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87752738/JAW.

This work describes an electron scattering experiment on the deuterium nucleus. We were interested in the structure function A(q/sup 2/) of this nucleus. This structure function is particularly sensitive to the nucleon-nucleon potential and to the neutron electric form factor. Cross sections have been measured at four incident energies: 200, 300, 500, 650 MeV and at scattering angles ranging from 30/sup 0/ to 120/sup 0/. The momentum transfer range between q/sup 2/ = 0.5 and q/sup 2/ = 18 fm/sup -2/ was covered. Special care was given to the accuracy of the data. We have studied in detail all experimental corrections, in order to measure absolute cross sections. Most of our data have statistical errors smaller than 1%. The overall accuracy of our cross sections was confirmed by quasi-simultaneous measurements on a hydrogen target. These measurements were found to be in perfect agreement with a prediction computed using a fit to the world data on the electric and magnetic form factors of the proton. We have also measured cross sections for the deuteron electrodesintegration at threshold. These measurements together with cross sections measured previously at 155/sup 0/ allow a separation of the longitudinal and transverse components of this process. The improved precision of our new data on the deuteron provide a stringent test for the presently available theoretical calculations. We have studied the sensitivity of A(q/sup 2/) to different theoretical ingredients. We have also shown that within some assumptions, our measurements permit a raisonable estimation of the uncertainty on the neutron electric form factor.

2353 **Isoscalar and isovector form factors of ^{3}H and ^{3}He for Q below 2.9 fm/sup -1/ from electron-scattering measurements.** Beck, D.; Bernstein, A.; Blomqvist, I.; Caplan, H.; Day, D.; Demos, P.; Dodge, W.; Dodson, G.; Dow, K.; Dytman, S.; and others. (Bates Linear Accelerator Laboratory and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **59**: No. 14, 1537-1540(5 Oct 1987).

The ^{3}H and ^{3}He charge and magnetic form factors have been extracted from cross-section measurements in the region 0.3approx. <Qapprox. <2.9 fm/sup -1/. The measurements have random uncertainties of about 2% and systematic uncertainties of about 2% for ^{3}H and 1.5% for ^{3}He. The small systematic uncertainties allow accurate determination of the isoscalar and isovector trinucleon form factors. The isoscalar charge and isovector magnetic form factors are in reasonable agreement with current theoretical models, whereas the isovector charge and isoscalar magnetic form factors show significant deviations from the models.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

2354 **(CEA-CONF—8728) Field description of nuclear spectra.** Gillet, V. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Oct 1986. 13p. (CEA-DPH-N-S—2390; CONF-8610253—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752745/JAW.

From 4. Franco-Japanese colloquium on nuclear spectroscopy; Seillac, France (7 Oct 1986).

We discuss the two-nucleon spectra of light and medium nuclei in terms of the meson exchange picture. In particular we compare the OBEP results with a more complete description including higher order processes. Also preliminary results on neutron single particle energies and total binding energies are presented.

2355 **(DOE/ER/40324—1) Nuclear research with heavy ions: Annual progress report for the period January 1, 1987-December 31, 1987.** Kaplan, M. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemistry). Sep 1987. Contract FG02-87ER40324. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001333/JAW.

The experimental research program is directed towards gaining an understanding of the behavior of very hot nuclear matter and the transformations which result in relaxation of various nuclear degrees of freedom or the formation of new nuclear states. We study the nuclear reactions between energetic heavy-ion projectiles and complex nuclei and explore the evolution of reaction mechanisms and decay properties with increasing excitation energy and angular momentum. Our recent work emphasizes the exploitation of light-charged-particle emission as a sensitive probe and indicator of the degree of thermal equilibrium and collective shape changes achieved at various stages of reaction. By using various detection systems to observe and identify the reaction products, we are tracking the dynamic progression of the reacting complex from the very early stages of the collision through the relatively longer time frames of equilibrium evaporation from separated and fully accelerated reaction fragments. An important objective of our experiments is to distinguish and identify the sources of charged particle emission in representative reactions, and to characterize the de-excitation properties of the emitters, particularly with regard to energy sharing and angular momentum transfer. Related compound-nucle-

ar-reaction processes are being studied to create models of decay patterns and to provide experimental data for calibrating the parameters of statistical model theoretical calculations. 23 refs., 9 figs., 3 tabs.

2356 **(GANIL-P—87-05) New mass measurements far from stability.** Gillibert, A.; Bianchi, L.; Mittig, W. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752713/JAW.

The mass excesses of several light neutron rich nuclei have measured, eight of them for the first time. Boron to Phosphorus nuclei produced by fragmentation of the /sup 40/Ar projectile at an incident energy e to 60 MeV/A. 11 refs.

2357 **(GANIL-P—87-06) Delayed-particle spectroscopy on very exotic nuclei at GANIL.** Mueller, A.C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Jan 1987. 16p. (CONF-870153—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752714/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

This paper describes recent developments concerning the spectroscopy of the preponderate decay mode of these nuclei far off stability: their high β decay energy 0/sub β/ opens up the window for decay into particle-unstable states of the daughter nucleus leading to β delayed proton or neutron emission in the case of very neutron-deficient or neutron-rich nuclei, respectively.

2358 **(INS—628) Coupled-isotriplet interpretation of the /sub Σ//sup 9/Be hypernuclear state.** Ikeda, K.; Yamada, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750066/JAW.

The /sub Σ//sup 9/Be hypernuclear state at E/sub Σ/ — 10 MeV is interpreted as a superposition of the coupled states between the nuclear isotriplet (/sup 8/Li, /sup 8/Be, /sup 8/B) and the isotriplet of Σ particle.

2359 **(KFK—4259) Experimental studies of the break-up of 156 MeV /sup 6/Li-ions at extreme forward angles using the Karlsruhe magnetic spectrograph 'Little John'.** Jelitto, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Heidelberg Univ. (Germany, F.R.). Fakultaet fuer Physik und Astronomie). May 1987. 146p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87753290/JAW.

/sup 6/Li-induced break-up reactions have been investigated at reaction angles in extreme forward direction including O/sup 0/ with the Karlsruhe Magnetic Spectrograph 'Little John'. The experiments were characterized by the minimization of the high experimental background that dominates at small emission angles. Inclusive alpha-particle and deuteron spectra from the bombardement of /sup 12/C- and /sup 208/Pb-targets with 156 MeV /sup 6/Li-ions have been measured. Below the grazing angle the Coulomb interaction shows a distinct influence on the angular distributions of the fragments. A simple spectator-model and a more realistic description within the DWBA-formalism largely allows a reproduction of the data. In the light of the reverse reaction $\alpha + d \rightarrow$ /sup 6/Li + γ at small α-d-relative energies, which is of considerable interest for astrophysics, a particle-particle-coincidence measurement with θ/sub α/ = 5/sup 0/ and θ/sub d/ = -2/sup 0/ has been performed. The result could be reproduced reasonably well by a simple Monte-Carlo-simulation. Beside the treatment of a physical problem this work deals with the start-up of the magnetic spectrograph and the clarification of spectrograph specific questions concerning the data reduction.

2360 **(KFKI—1987-23/A) Production of protons, deuterons and tritons on carbon by intermediate energy neutrons.** Eroe, J.; Fodor, Z.; Franz, J. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Apr 1987. 104p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700127/JAW.

Inclusive cross sections for production of protons, deuterons and tritons on carbon by neutrons in the energy range of 300-580 MeV were determined at nine angles between 51 deg and 165 deg. The invariant cross sections are well represented by an exponential fit. The slope parameters exhibit a systematic dependence on incident energy and emission angle. The results are discussed on the basis of the model of quasi-two-body scaling. 27 refs.; 15 figs.; 60 tables.

2361 **Polarization of Σ/sup 0/ hyperons in inclusive production from 28.5 GeV/c protons on beryllium.** Dukes, E.C.; Overseth, O.E.; Bunce, G.M.; Makdisi, Y.; Yamin, P.; Jensen, D.A.; Kreisler, M.N.; Marcin, M.; Raychaudhuri, K.K.; Sullivan, M.W. (Michigan Univ., Ann Arbor, USA. Dept. of Physics; Brookhaven National Lab., Upton, NY, USA; Massachusetts Univ., Amherst, USA. Dept. of Physics and Astronomy). *Physics Letters [Section] B;* **193**: No. 1, 135-139(9 Jul 1987).

The polarization of Σ/sup 0/ hyperons produced in an inclusive reaction has been measured for the first time. From a sample of 11 000 events produced by 28.5 GeV/c protons in the reaction p+Be -> Σ/sup 0/+X, the Σ/sup 0/ polarization has a value of +0.28+-0.13 at p/sub 1/ = 1.01 GeV/c and x/sub f/ = 0.60. The polarization of 53 000 Λ hyperons produced from 28.5 GeV/c protons in the reaction p+Be -> Λ+X has also been measured in the kinematic range 0.64 < p/sub t/ < 1.14 GeV/c and 0.42 < x/sub f/ < 0.62. The average Λ polarization is found to be -0.188+-0.024, consistent with previous results.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

2362 **(ANU-P—964) Reorientation effects for 52 MeV vector polarized deuterons.** Nurzynski, J.; Kihm, T.; Knopfle, K.T.; Mairle, G.; Clement, H. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Jan 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700095/JAW.

The differential cross sections and the vector analysing powers were measured for the elastic and inelastic scattering of 52 MeV vector polarized deuterons from /sup 20/Ne, /sup 22/Ne, /sup 26/Mg, /sup 28/Si, /sup 32/S, /sup 34/S, /sup 36/Ar and /sup 40/Ar nuclei. Coupled channels analysis was carried out using an axially symmetric rotational model with either prolate or oblate quadrupole deformations for each isotope. Calculations assuming harmonic vibrator model were also carried out. In general, reorientation effects were found to be weak. A global optical model potential containing an imaginary spin-orbit component was found to be the most suitable in describing the experimental data at this energy.

2363 **(GANIL-P—86-15) Fusion process in Landau-Vlasov dynamics.** Remaud, B.; Sebille, F.; Gregoire, C.; Vinet, L. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752695/JAW.

Central collisions in intermediate energy heavy ion reactions are studied in the framework of the Landau-Vlasov equation. The momentum relaxation and the nucleon emission into the continuum are analyzed with the excitation energy of the composite system. For light systems, the onset of an ineffectual fusion is obtained for an incident energy near the Fermi energy. For heavy systems, the incomplete fusion is the dominant mechanism in the whole energy range below 80 MeV/u.

2364 **(INS—612) Ion-guide isotope separator on-line for heavy ion reactions.** Nomura, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703588/JAW.

The ion-guide technique for on-line isotope separation has been introduced to the existing isotope-separator on-line (ISOL) at INS. Various properties of the ion-guide ISOL have been studied for its future use in heavy-ion reactions. In particular, we have measured the change of relative efficiencies of the system by changing beam intensity in reactions of /sup 27/Al(α,2pn)/sup 28/

Al, /sup 19/F(/sup 12/C,2pn)/sup 28/Al and /sup 12/C(/sup 19/F,2pn)/sup 28/Al. The result shows that the efficiency can be well expressed in terms of the product of beam intensity and energy loss of beam particles in the helium gas used, and that it decreases rapidly as the above product exceeds 10/sup 17/ eV/s, indicating an evidence for plasma effect for the first time. A small gas-filled recoil mass separator has also been made at INS and its properties have been studied in detail. A hybrid type of an ISOL system consisting of the recoil separator and the ion-guide ISOL is proposed for the study of short-lived activities produced in heavy-ion reactions such as those formed in target-fragmentation processes.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

2365 **(ANU-P—954) Transient-field strength measurements for /sup 52/Cr traversing Fe hosts at high velocity and polarization transfer mechanisms.** Stuchbery, A.E.; Doran, C.E.; Byrne, A.P.; Bolotin, H.H.; Dracoulis, G.D. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Dec 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700092/JAW.

Transient-field strengths were measured for /sup 52/Cr ions traversing polarized Fe hosts at velocities up to 12v>=o (v>=o = c/137 = Bohr velocity). The results are compared with predictions of various transient field parametrizations and discussed in terms of possible mechanisms by which polarization might be transferred from the Fe host to inner vacancies of the moving Cr ions. The g-factor of the first 2/sup +/ state of /sup 52/Cr was also measured by the transient field technique and found to be in accord with shell-model calculations.

2366 **(GSI—87-18-Prepr.) Isotopic yield ratios of complex fragments from intermediate energy heavy ion reactions.** Wada, R.; Hildenbrand, K.D.; Lynen, U.; Mueller, W.F.J.; Rabe, H.J.; Sann, H.; Stelzer, H.; Trautmann, W.; Trockel, R.; Brummund, N. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Muenster Univ. (Germany, F.R.); Frankfurt Univ. (Germany, F.R.); Heidelberg Univ. (Germany, F.R.)). Apr 1987. 15p. NTIS, PC E07; NTIS as TIB/B87-11074.

Isotopically resolved yields of intermediate mass fragments from /sup 12/C and /sup 13/O induced reactions on /sup 58,64/Ni, /sup nat/Ag, and /sup 197/Au at E/A=84 MeV were measured. The systematic variation of the yield ratios with projectile and target shows that these fragments are produced by a mechanism that involves the whole target nucleus. It is demonstrated that, within a statistical interpretation, the isotope yield ratios are a measure of the entropy and determine a relation between temperature and density at break-up.

2367 **(GSI—87-19-Prepr.) Recoil effects in peripheral nucleus-nucleus collisions at E/A=84 MeV.** Rabe, H.J.; Hildenbrand, K.D.; Lynen, U.; Mueller, W.F.J.; Sann, H.; Stelzer, H.; Trautmann, W.; Trockel, R.; Wada, R.; Pochodzalla, J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik; Muenster Univ. (Germany, F.R.). Inst. fuer Kernphysik; Heidelberg Univ. (Germany, F.R.)). Apr 1987. 15p. NTIS, PC E07; NTIS as TIB/B87-11072.

Azimuthal angular correlations between projectile fragments and light particles have been measured in /sup 18/O induced reactions on /sup 58,64/Ni and /sup 197/Au targets at E/A=84 MeV. Neither sequential projectile decay nor evaporation from an equilibrated target-like recoil can explain the observed correlations. The data are well described in terms of a sideways-moving source suggesting emission of midrapidity light particles from a subset of nucleons which carries a major part of the transverse recoil momentum imparted by the projectile fragment.

2368 **(GSI—87-21-Prepr.) Isotope yield ratios as a probe of the reaction dynamics.** Trautmann, W.; Hildenbrand, K.D.; Lynen, U.; Mueller, W.F.J.; Rabe, H.J.; Sann, H.; Stelzer, H.; Trockel, R.; Wada, R.; Brummund, N. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Muenster Univ. (Germany, F.R.); Frankfurt Univ. (Germany, F.R.); Heidelberg Univ. (Germany, F.R.)). Apr 1987. 15p. (CONF-8704188—1). NTIS, PC E07; NTIS as TIB/B87-11073.

From Symposium on central collisions and fragmentation processes; Denver, CO, USA (7 Apr 1987).

Isotopically resolved yields of particles and complex fragments from /sup 12/C and /sup 18/O induced reactions on /sup 53/Ni, /sup 54/Ni, Ag, and /sup 197/Au in the intermediate range of bombarding energies 30 MeV ≦ E/A ≦ 84 MeV were measured. The systematic variation of the deduced isotope yield ratios with projectile and target is used to determine the degree of N/Z equilibration achieved and to establish time scales for the reaction process. A quantum statistical model is employed in order to derive entropies of the emitting systems from the measured isotope yield ratios.

2369 **(INIS-BR—816) Weak transition of /sup 44/Ca.** Tauhata, L. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1971. 93p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703714/JAW.

A study of the nuclear core contribution to the excited nuclear states was done, along with its theoretical evaluation and interpretation, in the light nuclei region. The 727 KeV gamma ray transition between the 1885 KeV O/sup +/ and 1157 KeV - 2/sup +/ states was detected, putting in evidence experimentally, the possibility of the 0/sup +/ state, characterized as core excitation, and found to be by /sup +/ decay or electron capture from/sup 44,44m/Sc. The formation of the 2850 KeV state, due to 880 KeV transition from the 3667 KeV state, is re-discussed. The 564 KeV and 1684 KeV transitions from the 2850 KeV state to the 2285 KeV and 1157 KeV states, respectively, are also discussed. A new scheme is proposed for the /sup 44/Ca excited states.

2370 **(INIS-mf—10985) Core polarisation and configuration mixing in /sup 58/Ni studied by high resolution electron scattering.** Blok, H. (Vrije Univ., Amsterdam (Netherlands)). 4 Jun 1986. 112p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703572/JAW.

The nucleus /sup 58/Ni is studied by inelastic electron-scattering. This nucleus has two valence neutrons outside a closed /sup 58/Ni core which implies that no valence protons contribute to the transitions and thus, besides configuration mixing of the valence neutrons, proton-core polarization can be studied in detail. From inelastic electron-scattering data one obtains the charge- and current-transition densities by determining the Fourier-Bessel transform of the cross sections measured over a wide range of linear momenta transferred to the nucleus. The results of an analysis of the excitation of two 0/sup ++/ states at low-momentum transfer are presented. These transitions are particularly interesting for studying core-polarization contributions. (Auth.). Includes Dutch summary

6516 Nuclear Properties And Reactions, A=59-89, Experimental

2371 **(ANU-P—956) Excitation of swift heavy ions in foil targets. 3. Initial populations of Rydberg states.** Hay, H.J.; Treacy, P.B. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Feb 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700093/JAW.

Results are reviewed of experiments in which Rydberg states with high principal quantum numbers (n ≧ 20) are excited by foil targets in transmitted heavy ions. A uniform procedure is described for analysis of the decays downstream of such states using a Monte Carlo method. Previously-observed X-ray decays of 130 MeV Br Rydberg ions into L-vacancies are analysed and numerical populations of initially-generated states are deduced. It is found that the initial states may be described as mainly statistical, i.e. all substates having equal weights, with 63% of initial ions in such states. Some

X-ray lines are found to come from high-n (≧ 50) low-l (≦ 2) states. There is evidence for an unknown post-foil mechanism feeding the 3s-electron state.

2372 **Nuclear structure of /sup 86,87/Rb from /sup 87,88/Sr(d,/sup 3/He) at 28 MeV.** Li, P.C.; Daehnick, W.W.; Saha, S.K.; Brown, J.D.; Kouzes, R.T. (Pittsburgh Univ., PA, USA. Nuclear Physics Lab.; Princeton Univ., NJ, USA. Joseph Henry Labs.). *Nuclear Physics [Section] A;* 469: No. 3, 393-406(3 Aug 1987).

Differential cross sections for /sup 87/Sr(d,/sup 3/He)/sup 86/Rb and /sup 88/Sr(d,/sup 3/He)/sup 87/Rb were measured with the Princeton 27.9 MeV deuteron beam and the quadrupole-dipole-dipole-dipole (QDDD) spectrograph. States of /sup 86/Rb and /sup 87/Rb up to 1.74 MeV and 1.58 MeV, respectively, were studied with a total resolution of 16 keV. Zero-range distorted-wave Born approximation (DWBA) calculations were used to determine l transfers and spectroscopic strengths. If the targets are described as a closed shell for /sup 88/Sr and as (νg/sub 9/2/)/sup -1/ for /sup 87/Sr, only the /sup 88/Sr(d,/sup 3/He)/sup 87/Rb spectroscopic strengths are close to shell model expectations. The observed /sup 87/Sr(d,/sup 3/He)/sup 86/Rb strengths fall 25% below the shell model sum rule. Hence the data suggest that the proton wave functions of /sup 87/Sr contain appreciably more configuration mixing than those of /sup 88/Sr. Values for the (πf/sub 5/2/, νg/sub 9/2/) residual interaction matrix elements are proposed, but must remain tentative until the shortfall of f/sub 5/2/ strength is understood.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

2373 **(INIS-BR—717) Study of alpha activity in the region of rare earths.** Cunha, P.G. da. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1978. 103p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703469/JAW.

The alpha decay half-lives of the Nd/sup 144/, Cd/sup 152/ and Er/sup 162/ isotopes were redetermined using Ilford L4 nuclear emulsions charged with rare earth complexes of natural isotopic composition. The results were compared to results obtained by other authors, and with results calculated by potential barrier penetration theory. (M.C.K.).

2374 **(INS—615) Possible isomers in nuclei beyond the drip line.** Ogawa, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Dec 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703590/JAW.

To search a new decay model which is not observed in nuclei near stability line such as beta-delayed proton emission or direct proton emission provides us a wealth of knowledge on nuclear stability. Besides study of the nuclear decay modes, study of nuclear structures reveals us new aspect of nuclei like new deformed regions or new magic numbers. In these respects the study of a nucleus /sup 100/Sn and its closest neighbours has a special role.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

2375 **(ANU-P—953) Transient field for W ions traversing Fe hosts and for Os ions traversing Fe and Ni hosts.** Stuchbery, A.E.; Bolotin, H.H.; Doran, C.E. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Feb 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700091/JAW.

Transient field strengths were measured for /sup 184/W and /sup 186/W ions traversing thin, magnetized Fe foils with velocities in the range $1.8 \leqq v/v>=o \leqq 5.7$ (v>=o Bohr velocity) and for /sup 188/Os, /sup 190/Os, /sup 192/Os ions traversing polarized Ni hosts with average velocities $<v/v>=o> - 4$. The present measured transient field strengths, together with previously measured results for W, Os ions, are compared with transient-field strength parametrizations, and discussed in terms of microscopic models of the transient field.

2376 **(CEA-CONF—8874) Reaction mechanisms in the transition region.** Volant, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). Nov 1986. 3p. (In French). (CEA-DPH-N-S—2402B; CONF-8611138—6-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752916/JAW.

From Saturne workshop; La Londe-les-Maures, France (10 Nov 1986).

2377 **(CONF-870970—6) Low energy E0 transitions in odd-mass nuclei of the neutron deficient 180 < A < 200 region.** Zganjar, E.F.; Kortelahti, M.O.; Wood, J.L.; Papanicolopulos, C.D. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy; Georgia Inst. of Tech., Atlanta (USA). School of Physics). 1987. Contract AC05-84OR21400;FG05-84ER40159;FG05-87ER40330. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000586/JAW.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

The region of neutron-deficient nuclei near Z = 82 and N = 104 provides the most extensive example of low-energy shape coexistence anywhere on the mass surface. It is shown that E0 and E0 admixed transitions may be used as a fingerprint to identify shape coexistence in odd-mass nuclei. It is also shown that all the known cases of low energy E0 and E0 admixed transitions in odd-mass nuclei occur where equally low-lying O^+ states occur in neighboring even-even nuclei. A discussion of these and other relevant data as well as suggestions for new studies which may help to clarify and, more importantly, quantify the connection between E0 transitions and shape coexistence are presented. 60 refs., 7 figs., 4 tabs.

2378 **(DOE/ER/40162—T2) Light particle emission measurements in heavy ion reactions: Progress report, June 1, 1986-May 31, 1987.** Petitt, G.A. (Georgia State Univ., Atlanta (USA). Dept. of Physics and Astronomy). 1987. Contract FG05-84ER40162. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000161/JAW.

During the past year we have completed our work on neutron emission in coincidence with fission fragments from the ^{158}Er system. In addition to this we have completed preliminary analysis of our results on neutron emission from products of damped reactions between ^{58}Ni and ^{165}Ho at 930 MeV. Two experiments were planned for the present contract period as discussed in our proposal for 1986-87. One of these, to measure the mass and charge distributions from projectile-like fragments (PLF) in the reactions ^{58}Ni + ^{165}Ho and ^{58}Ni + ^{58}Ni using the time-of-flight facility at the HHIRF has been successfully completed. The other, to measure momentum correlations between neutrons and charged particles produced in central collisions between ^{32}S + ^{197}Au is scheduled to be run in mid-February. 14 refs., 4 figs.

2379 **(GSI—87-33-Prepr.) Decay of the new isotope /sup 180/Yb and the search for the r-process path to /sup 180m/Ta.** Runte, E.; Schmidt-Ott, W.D.; Eschner, W.; Rosner, I.; Kirchner, R.; Klepper, O.; Rykaczewski, K. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Goettingen Univ. (Germany, F.R.). 2. Physikalisches Inst.). Jun 1987. 12p. Also published in Z. Phys., A (Sep 1987) Vol. 328(1) p. 119-122.

Irradiating /sup nat/W/Ta targets with /sup 186/W, the decay of the new isotope /sup 180/Yb was observed and its half-life determined to be 2.4 (5) min. Based on the measured β-, γ- and X-ray data, the r-process production of /sup 180m/Ta and the role of a possible isomer /sup 180m/Lu in this context are discussed.

2380 **(INS—622) Large area and very thin /sup 169/Yb β-source as an energy reference in the neutrino mass measurement with /sup 3/H β-decay.** Shibata, S.; Shoji, Y.; Sugai, I. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750060/JAW.

Thin sources of radioactive /sup 169/Yb were prepared as an absolute energy reference for β-rays from tritium decay in the neutrino mass measurement. The isotope /sup 169/Yb was produced by bombarding erbium metal with α particles, and was separated and purified chemically. Sources were prepared by vacuum deposition of /sup 169/Yb onto conductive plates having a size of 40 x 50 mm/sup 2/ or 25 x 100 mm/sup 2/ and had an intensity of 20 - 50 μCi. The intensity variation over the entire source surface was within +- 10 %. Conversion electron spectra from /sup 169/Yb were measured with an iron-free β-ray spectrometer to examine the source quality.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

2381 (ANU-P—963) Experimental determination of the electric quadrupole moment of the first excited state of /sup 192/Pt. Gyapong, G.J.; Spear, R.H.; Fewell, M.P.; Baxter, A.M.; Burnett, S.M. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Apr 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700094/JAW.

Coulomb excitation by /sup 4/He, /sup 12/C and /sup 16/O projectiles has been used to determine the static electric quadrupole moment Q(2/sub 1//sup +/) of the first excited state of /sup 192/Pt, together with the value of B(E2;0/sub 1//sup +/ -> 2/sub 1//sup +/). As with /sup 194/Pt, /sup 196/Pt, and /sup 198/Pt, it is found that Q(2/sub 1//sup +/) for /sup 192/Pt is clearly positive, having the value 0.55 (21) eb. The value obtained for B(E2;0/sub 1//sup +/ -> 2/sub 1//sup +/) is 1.833 (20) e/sup 2/b/sup 2/. The result obtained for Q(2/sub 1//sup +/) supports the view that the prolate-to-oblate transition in the platinum isotopes is quite different from that in the osmium isotopes. The shape change is more sensitive to Z than N. The results are compared with the predictions of various nuclear models.

2382 (ANU-P—966) Valence configurations in /sup 214/Rn. Dracoulis, G.D.; Byrne, A.P.; Stuchbery, A.E.; Bark, R.A.; Poletti, A.R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Jan 1987. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700096/JAW.

Excited states of /sup 214/Rn, up to spins of — 24 Planck constant have been studied using γ-ray and electron spectroscopy following the /sup 208/Pb(/sup 9/Be,3n) /sup 214/Rn reaction. The level scheme (which differs substantially from earlier work) is compared with the results of a semi-empirical shell model calculation. The availability of high spin orbitals for the four valence protons and two valence neutrons, and the effect of the attractive proton-neutron interaction, leads to the prediction of high-spin states at an unusually low excitation energy. Experimentally, the high level density leads to difficulties in the level scheme assignments at high spin. Nevertheless, configuration assignments, supported by transition strengths deduced from the measured lifetimes (in the nanosecond region) are suggested for the main yrast states. The decay properties also suggest that configuration mixing is important. The possibility of a gradual transition to octupole deformation, implied by the decay properties of the 11/sup -/ and 10/sup +/ yrast states is also discussed.

2383 (CONF-8706193—4) Nuclear shapes from heavy ion inelastic scattering. Vourvopoulos, G.; Humphrey, D.L.; Vancleve, T.; Hensley, D.C.; Gross, E.E. (Western Kentucky Univ., Bowling Green (USA). Dept. of Physics and Astronomy; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000584/JAW.

From International conference on nuclear shapes; Crete, Greece (28 Jun 1987).

Earlier inelastic scattering experiments at energies above the Coulomb barrier have shown that angular distributions for the ground state and strongly coupled excited states can provide an accurate determination of a number of nuclear deformation parameters. An inelastic scattering experiment of ^{24}Mg on ^{208}Pb indicates that indeed this is a viable technique. 8 refs., 2 figs., 2 tabs.

2384 (GANIL-P—86-29) Neutron energy distributions in the dynamical competition between evaporation and fission. Gregoire, C.; Delagrange, H.; Pomorski, K.; Dietrich, K. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752735/JAW.

So far theoretical investigations on the abnormal emission of light particles in competition with fission have dealt only with the total number of emitted particles. In this study, a first step in calculations of energy spectra is attempted in the framework of transport equation describing the evolution of an excited nucleus toward fission. We stress the role of differential multiplicities as qualified strobes to gain knowledge on the dynamical evolution of the fission process.

2385 (GANIL-P—87-09) Possible evidence for Fermi-jets and mean-field effects from asymmetries in particle-particle correlations at 60 A MeV/sup +/-. Ardouin, D. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Jan 1987. 16p. (CONF-870153—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752716/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

Two-particle inclusive and exclusive correlations have been studied on Ar + Au and Ar + Ti collisions at 60 A MeV. From observed azimuthal and polar asymmetries and Landau-Vlasov calculations, we deduce signatures of mean-field effects and Fermi-Jets type-processes.

2386 (GSI—86-49-Prepr.) Consequences of sudden rearrangements of electronic shells. Reus, T. de; Soff, G.; Graf, O.; Greiner, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). Nov 1986. 14p. NTIS, PC E07; NTIS as TIB/B87-11438.

We investigate the influence of sudden rearrangement processes in the electron distribution of the two-centre potential on electron and positron spectra emitted in heavy ion collisions. Using a schematic ansatz for the matrix elements, a scaling law is deduced, which predicts oscillations in the emission spectra. Coincident electron-positron emission in the system Pb+Pb at E/sub Lab/=5.7 MeV/n was evaluated using a full coupled channel code under the assumption that the rearrangement effects may be simulated by adding a Gaussian to the matrix elements at position R/sub 8/. Pronounced structures are found for certain cuts in the plane spanned by the kinetic electron and positron energies. Surprisingly, electron and positron production cross sections peak at the same energies. Hence there is great resemblance of this phenomenon with experimental observations on e/sup +/-e/sup -/ spectra in heavy ion collisions.

2387 (INIS-BR—791) Bi/sup 209/ alpha activity. Araujo Penna, M.M. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1970. 89p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703534/JAW.

The study for measuring Bi/sup 209/ alpha activity is presented. Ilford L4 nuclear emulsion pellicles loaded with bismuth citrate to obtain a load of 100 mg/cm/sup 3/ of dry emulsion, were prepared. Other pellicles were prepared with the same. Ilford L4 gel to estimate the background radiation. To observe 'fading' effect, pellicles loaded with bismuth were submitted to neutrons of high energy, aiming to record recoil proton tracks. The pellicles were confined in nitrogen atmosphere at temperature lower than -10/sup 0/C. The Bi/sup 209/ experimental half-life was obtained and compared with the estimated theoretical data. (M.C.K.).

2388 (INS—614) Shell-model study of the first forbidden /sup 205/Tl -> /sup 205/Pb transition and solar neutrino detection. Ogawa, K.; Arita, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Dec 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703589/JAW.

The first-forbidden beta transitions from /sup 205/Tl to low-lying states in /sup 205/Pb, which are possibly induced by capturing very low-energy neutrinos, are investigated theoretically. A result of a tentative calculation is presented. For more quantitative prediction several problems in shell-model calculation of these nuclei and also in evaluation of the beta matrix elements are discussed.

2389 (IPNO-DRE—86-15) Old and new 0(6) nuclei. Vergnes, M.; Berrier-Ronsin, G.; Rotbard, G.; Vernotte, J.; Tamisier, R. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752731/JAW.

The nucleus /sup 196/Pt, considered as the best example of an O(6) nucleus has been alternatively described recently as a U(5) nucleus. In the first part of this paper, we have reviewed the large available body of transfer reactions data, both one nucleon and two nucleon transfer, and compared the results for the Pt and Hg isotopes. The lightest Hg isotopes appear as rather well described by the U(5) limit. For the heaviest Pt isotopes, no evidence against the 0(6) character has been found and many pieces of data, buttressing each other (in particular the g.s. reversible g.s two neutron transfer enhancement factor behaviour), are rather in favour of it. In the second part of this paper, following a recent suggestion that the Ba region is even better than the Pt region for the realization of the 0(6) symmetry, we have investigated the possibility to find in this area even-even and odd-A partners reasonably described by the U(6/4) model. A first analysis of the energy levels of even-even nuclei shows a reasonable fit with parameters obtained by scaling the ones used for /sup 196/Pt. With the same parameters, very good fits are obtained for /sup 133/Xe and /sup 135/Ba. The neutron pick-up (d,t) reaction, performed in Orsay at 25.2 MeV has been used as a further test: there is a reasonable agreement between the experimental transfer intensities and the ones predicted by the U(6/4) model. In summary, there are indications of a possible realization of the U(6/4) supersymmetry in the /sup 134/, /sup 135/, / sup 136/Ba and perhaps in the /sup 132,/ /sup 133,/ /sup 134/Xe isotopes.

2390 (IPNO-DRE—86-16) Damping of high-spin single-particle strengths in /sup 209/Pb. Massolo, C.P.; Azaiez, F.; Gales, S.; Fortier, S.; Gerlic, E.; Guillot, J.; Hourani, E.; Maison, J.M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752732/JAW.

The stripping reaction (α, /sup 3/He) at 183 MeV incident energy has been used to study the neutron-particle response function on /sup 208/Pb target nucleus up to 15 MeV excitation energy. Detailed spectroscopic information has been obtained on the low-lying neutron states (0-4 MeV) through angular distribution measurements and standard distorted wave Born approximation analysis. A large enhancement of cross section is observed between 5 and 15 MeV. It appears as a broad bump superimposed on a continuous background which has been analysed within the framework of the plane wave break-up model. The excitation energies, angular distributions and strengths of these high-lying transitions suggest that they arise from neutron stripping to high-spin outer subshells, i.e. 2h/sub 11/2/, 1k/sub 17/2/ and 1j/sub 13/2/ in /sup 209/Pb. The results are compared with predictions from the core-particle model and from the quasiparticle-phonon model.

2391 (IPNO-DRE—86-17) Proton hole response function on /sup 196/Pt and /sup 197/Au transitional target nuclei up to high excitation energy. Langevin-Joliot, H.; Gerlic, E.; Guillot, J.; Van de Wiele, J.; Werf, S.Y. van der; Blasi, N. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 58p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87752733/JAW.

The proton hole response functions have been studied on the transitional target nuclei /sup 196/Pt and /sup 197/Au via the (d, / sup 3/He) reaction at E/sub d/ = 108.4 MeV, up to 6 MeV and 18.5 MeV excitation energy respectively. /sup 196/Pt low lying levels have been studied in addition at E/sub d/ = 50 MeV. Spectroscopic information gained on the low lying levels in the /sup 195/Ir and /sup 196/Pt residual nuclei allows the discussion of the 3s/sub 1/2/ and 2d/sub 3/2/ orbital filling. For both /sup 195/Ir and /sup 196/Pt, new 2d/sub 5/2/ and 1h/sub 11/2/ levels or groups are observed. The /sup 196/Pt spectra exhibit a broad bump between 6 and 15 MeV excitation energy riding over a continuous background. The study of the excitation energy spectra up to 27 MeV leads to a consistent subtraction of the background. The contributions of the 1g/sub 9/2/, 2p and 1f inner hole strengths are deduced by least square fits of DWBA angular distributions. About the whole 1g/sub 9/2/ and 2p inner hole strengths and 50% of the 1f strengths are found below E/sub x/ = 18.5 MeV. The background correction is also used to reanalyse previous data obtained via the same reaction on the spherical /sup 208/Pb target for comparison. Experimental results on centroid separation energies are compared with Hartree Fock predictions. The spreading widths and specific features of the strength distribution shapes in /sup 195/ Ir and /sup 196/Pt and /sup 207/Tl are discussed in connection with the dominant quadrupole collective degrees of freedom of the two first nuclei contrasting with the strong vibrational modes in / sup 207/Tl. The valence hole fragmentation in /sup 195/Ir is described in the framework of the Core-Quasi-Particle-Coupling-Model.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

2392 (CEA-CONF—8860) Experimental study of cold fragmentation in ^{235}U and ^{239}Pu fission induced by thermal neutrons. Simon, G.; Trochon, J.; Signarbieux, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Oct 1986. 36p. (In French). (CONF-8610289—2). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752906/JAW.

From Fission meeting; Arcachon, France (14 Oct 1986).

An experimental study as comprehensive as possible of cold fragmentation has been made. A double ionization chamber with Frisch grids has been used, to have very good' energy resolution. As needed by the experiment together with very high efficiency to collect such rare events as fission without neutron emission. New results of ^{235}U fission are given, with a better statistics, and results for ^{233}U and ^{239}Pu fission are given. A complete mass separation of fragmentations has been realized. Signal amplitude from the detector have been carefully calibrated in energy, allowing direct comparison between reaction balance (Q) and maximum total kinetic energy. Charge division identification of fragments showed some deformation properties of fragments. Observed even-odd effect is analyzed. Results are compared to adiabatic model predictions.

2393 (CEA-CONF—8861) High resolution fission probabilities of reactions (d,pf) ^{229}Th, ^{230}Th, ^{232}Th and ^{233}U, ^{236}U. Blons, J.; Fabbro, B.; Hisleur, J.M.; Mazur, C.; Patin, Y.; Paya, D.; Ribrag, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Oct 1986. 17p. (In French). (CEA-DPH-N-S—2399; CONF-8610289—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752907/JAW.

From Fission meeting; Arcachon, France (14 Oct 1986).

Fission probabilities and related angular distribution have been measured with Saclay Van de Graaf for ^{229}Th, ^{230}Th, ^{232}Th and ^{233}U, ^{236}U nuclei. Energy resolution was 7 KeV except for ^{229}Th(d,pf) reaction for which it was 12 KeV. Experimental data have been analyzed from DWBA evaluation and penetrability calculation of a triple fission barrier. Fine structure analysis around fission threshold for thorium isotopes reinforce rotation band interpretation got with neutron reactions. Excitation functions of ^{234}U shows numerous resonant levels whose angular distribution suggest second well belonging. This effect disappears for ^{237}U nucleus except an accident that could be explained by coupling between states of second and third fission wells.

2394 (DOE/ER/40275—T1) Neutron cross section standards and instrumentation: Annual report. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). 28 Aug 1987. Contract AI01-86ER40275. 95p. NTIS, PC A05. Order Number DE88000959/JAW.

This annual report from the National Bureau of Standards contains a summary of the results of the Neutron Cross Section Standards and Instrumentation Program. The technical measurements for the past year are given along with the proposed program and budget needs for the next three years. The neutron standards measurements have concentrated on the most important $^{235}U(n,f)$ cross section in the thermal to 20 MeV energy range along with the development of neutron detectors required for these measurements. The NBS measurements have made a significant contribution to the improvement in the understanding of this reaction. Measurements were performed with numerous neutron detectors at overlapping energies and at different neutron sources in order to reduce the systematic errors to achieve the required accuracy in this important neutron standard. Significant progress was also made in the development of a detector to utilize the $^{3}He(n,p)$ reaction as a standard in the eV to MeV energy region. Improvements in data acquisition systems as well as additional studies of advanced neutron sources were accomplished. Contacts with private industry were maintained and coordination of the neutron standards evaluation was continued. The report also includes biographical listings of the research staff along with copies of a few of our recent publications. 13 figs., 1 tab.

2395 **(DOE/ER/40305—1) Composite delayed neutron energy spectra of fissionable isotopes: Progress report, September 1, 1986-August 31, 1987.** Couchell, G.P.; Schier, W.A. (Lowell Univ., MA (USA). Dept. of Physics and Applied Physics). 1987. Contract FG02-86ER40305. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000637/JAW.

During this present contract period we have so far: (1) completed our studies of the time-dependent DN spectra following thermal fission of Pu-239; (2) measured the upper energy region of the DN spectra in four delay-time intervals following fast fission of U-238; and (3) measured the equilibrium DN spectra for U-235, U-238 and Pu-239 in the same upper energy region. In addition, we have developed an analytical technique for extracting Keepin six-group energy spectra from measured time-dependent spectra which largely overcomes the deficiencies of earlier methods of analysis. Four papers on our DN investigations have also been prepared for publication, two of which are already in print. By the end of this period we shall complete our measurements of the higher energy portion of the DN spectra for the remaining three U-238 time intervals and also for the equilibrium spectrum from fast fission of U-235.

2396 **(INIS-BR—728) Disintegration constant of uranium-238 by spontaneous fission redetermined by glass track method.** Lima Medeiros, E. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1978. 116p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703480/JAW.

The disintegration constant of U/sup 238/ by spontaneous fission using glass as fission fragment detector was redetermined. A film of natural uranium (UO/sub 3/) prepared by chemical methods on the glass lamina was used in a long time experience of exposure (about 16 years). The good conditions of sample preparation and storage allow to observe, after chemical etching, fission fragment tracks. (M.C.K.).

2397 **(INIS-BR—729) /sup 238/U spontaneous fission half-life and a new probable radioactivity mode.** Souza, I.O. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1975. 92p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703481/JAW.

The /sup 238/U spontaneous fission half-life is reinvestigated using a special nuclear emulsion technique previously developed in our laboratory. A perfect visualisation of the fission fragments tracks in the absence of alpha particle tracks was obtained with the present method that also avoids the fading of the latent image. Under these conditions, two well defined peaks are observed experimentaly: one corresponding to the well-known range (approx 24 μm) of the /sup 238/U fission fragments tracks and the other showing evidence of short range tracks (approx 10 μm). For the /sup 238/U spontaneous fission half-life our result is (6.0/sup +/-0.4) x 10/sup 15/ y, in good agreement with the values obtained by some other workers using different experimental methods. A systematic theoretical analysis shows that the /sup 238/U spontaneous emission of nuclides with mass number between approx 20 e 70 is possible. The Kinetic energies calculated for these nuclides are found to fit the short range tracks observed in our experiment. From the experimental data, we attribute a (2 /sup +/- 1) x 10/sup 15/ y half-life for all modes of emission involved in this process.

2398 **(INIS-BR—785) Use of proportional gas scintillator in absolute measurements of alpha-gamma emitter activities.** Tobias, C.C.B. (Pontificia Univ. Catolica de Sao Paulo (Brazil)). 1987. 127p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703703/JAW.

The absolute activity of U-235 contained in a U/sub 3/ O/sub 8/ sample was measured utilizing a sum-coincidence circuit which selects only the alpha particles which are simultaneous with the 143 KeV and 186 KeV gamma radiations from the Th-231 (product nucleus). The alpha particles were detected by means of a new type of a gas scintillating chamber, in which the light emitted by excitation of the gas atoms, due to the passage of a charged incoming particle, has its intensity increased by the action of an applied electric field. The gamma radiations were detected by means of a NaI(Tl) 1" x 1/sup 1/2"/ scintillation detector. The value obtained for the half-life of U-235 was compared with the data available from various observers which used different experimental techniques. It is shown tht the results, are in excellent agreement with the best international data available on the subject and that, therefore, the sum-coincidence technique constitutes an important method for such measurements.

2399 **(INIS-BR—790) Uranium, thorium and bismuth photofission cross sections at high energies.** Tavares, O.A.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1973. 175p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87703705/JAW.

The U/sup 238/, Th/sup 232/ and Bi/sup 209/ photofission using nuclear emulsion technique for fission fragments detection is presented. The photofission cross sections were measured using Bremsstrahlung photon which were produced irradiating thin tungsten radiators with electrons accelerated at the energy range from 1,0 to 5,5 GeV in the "Deutsches Elektronen Synchrotron" (Hamburg), and aluminium radiator with electrons accelarated at 16,0 GeV in Stanford Linear Accelerator Center. A special revelation technique for nuclear emulsion pellicles loaded with uranium and thorium, allowed the discrimination between alpha particles tracks and fission fragments tracks. The results show a decrease in the cross sections, which is in good agreement, within experimental errors, with the conclusions of other authors. The estimations from the two-step mechanism for high energy nuclear reactions (intranuclear cascade followed by fission-evaporation competition) show that, the primary interaction according to the photomesonic model and the quasi-deuteron photon interaction are sufficient to explain the general behavior exhibited by photofission cross sections for investigated nuclei. The calculations show a resonant structure around 300 MeV, with a width at half maximum of 200 MeV, and another not so pronounced, near to 700 MeV.

2400 **(INIS-BR—792) U, Th and Bi fission induced by protons of 600 MeV.** Baptista, G.B. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1970. 86p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703535/JAW.

The measurements of U, Bi an Th fission cross sections induced by protons of 600 MeV were carried out, using nuclear emulsion techniques. The targets were prepared from KO Ilford type emulsion using solutions of U, Bi and Th complexes for its loading. The proton beam of 586 +- 5 MeV and integrated flux of 1,6 (+- 4,890) x 10/sup 11/ protons from CERN Synchro-Cyclotron was used for irradiating nuclear emulsions. The integrated flux was carried from aluminium desintegration curves by Al/sup 22/ (p, 3pn) Na/sup 24/ reaction. The fission events, were observed using Leitz microscopy and the statistical error of 10% were calculated. (M.C.K.).

2401 **(IPNO-T—86-04) Study of the spectroscopic properties of Neptunium IV in the ThSiO/sub 4/ and ThO/sub 2/ monocrystal matrices.** Lahalle, M.P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 132p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87752729/JAW.

Crystals of ThSiO/sub 4/ with a tetragonal structure, doped with neptunium 237 were grown by the flux method. The crystallographic structure of the obtained crystals has been confirmed at room temperature by X-rays diffraction. Raman diffusion experiments performed between 300 K and 4.2 K have shown that no phase transition occurs at low temperature. Then, the site symmetry of Np/sup 4+/ in ThSiO/sub 4/ remains D/sub 2d/ at 4.2 K. On the optical polarized absorption spectra of ThSiO/sub 4/:Np/sup 4+/, most of the excitated Stark levels coming from the first J states /sup 4/I/sub 11/2/, /sup 4/F/sub 3/2/ and /sup 4/I/sub 13/2/ have been assigned. Moreover, fluorescence experiments have permitted to identify two of the Stark components of the lower multiplet /sup 4/I/sub 9/2/. On the whole, 29 energy levels have been used for the spectroscopic parameter calculations which defined the crystal field interaction. The cubic structure of the thorium dioxide provides an O/sub h/ symmetry for the Np/sup 4+/ ions. Owing to the existence of an inversion center in such a symmetry, the pure dipolar electric transitions are theoretically forbidden and only the vibronic transitions are allowed. This results in a more difficult analysis than for ThSiO/sub 4/. The combined analysis of the spectra recorder at 4.2 K and higher temperatures allows us to deduce the pure electronic transitions. A first interpretation has permitted to identify about fifteen excitated Stark levels of Np/sup 4+/.

2402 **(UCID—21200) Fission fragment angular distribution for the ^{232}Th(n,f) reaction.** Becker, J.A.; Bauer, R.W. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001456/JAW.

Tables of the angular distribution of fission fragments produced in the ^{232}Th(n,f) reaction are presented for 0.72 ≦ E/sub n/ (MeV) ≦ 31.0. 5 refs., 1 tab.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 2060, 2202, 2223, 2233, 2331, 2344, 2346, 2347, 2350, 2354, 2384, 2385, 2389, 2397

2403 **(ANU-P—951) Relationship between the electric quadrupole properties of the Bohr-Mottelson and interacting-boson models.** Fewell, M.P. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Apr 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700090/JAW.

Elementary considerations show that the interacting boson model (version 1) contains a degree of freedom not present in the Bohr-Mottelson model. This is illustrated with a simple example. The additional degree of freedom obscures the relationship between the static quadrupole moment and the shape of the nucleus.

2404 **(ATOMKI-A—18-1987) Electromagnetic properties of /sup 6/Li in a cluster model with breathing clusters.** Kruppa, A.T.; Beck, R.; Dickmann, F. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). 1987. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700104/JAW.

Electromagnetic properties of /sup 6/Li are studied using a microscopic (α+δ) cluster model. In addition to the ground state of the clusters, their breathing excited states are included in the wave function in order to take into account the distortion of the clusters. The elastic charge form factor is in good agreement with experiment up to a momentum transfer of 8 fm/sup -2/. The ground state magnetic form factor and the inelastic charge form factor are also well described. The effect of the breathing states of α on the form factors proves to be negligible except at high momentum transfer. The ground-state charge density, rms charge radius, the magnetic dipole moment and a reduced transition strength are also obtained in fair agreement with experiment. 78 refs.; 11 figs.; 4 tables

2405 **(BONN-HE—87-11) Neutron-deuteron scattering calculations with W-matrix representation of the two-body input.** Bartnik, E.A.; Haberzettl, H.; Januschke, T.; Kerwath, U.; Sandhas, W. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). May 1987. 21p. NTIS, PC E07; NTIS as TIB/B87-11459.

Employing the W-matrix representation of the partial-wave T matrix introduced by Bartnik, Haberzettl, and Sandhas, we show for the example of the Malfliet-Tjon potentials I and III that the single-term separable part of the W-matrix representation, when used as input in three-nucleon neutron-deuteron scattering calculations, is fully capable of reproducing the exact results obtained by Kloet and Tjon. This approximate two-body input not only satisfies the two-body off-shell unitarity relation but, moreover, it also contains a parameter which may be used in optimizing the three-body data. We present numerical evidence that there exists a variational (minimum) principle for the determination of the three-body binding energy which allows one to choose this parameter also in the absence of an exact reference calculation. Our results for neutron-deuteron scattering show that it is precisely this choice of the parameter which provides optimal scattering data. We conclude that the W-matrix approach, despite its simplicity, is a remarkably efficient tool for high-quality three-nucleon calculations.

2406 **(CEA-CONF—8862) Fission dynamics as brought out in cold fragmentation studies.** Signarbieux, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). Oct 1986. 12p. (In French). (CEA-DPH-N-S—2398; CONF-8610289—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752908/JAW.

From Fission meeting; Arcachon, France (14 Oct 1986).

Fission dynamics problem has been addressed since the beginning. This paper is specifically concerned by even-odd effects in fragment distribution. These effects are reinterpreted, some complementary thoughts on double ionization chamber are given together with a study of fission dymanics at low energy.

2407 **(CEA-CONF—8871) Ultra-relativistic heavy ion collisions.** Soyeur, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Nov 1986. 10p. (In French). (CEA-SPhT—86-169; CONF-8611138—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752914/JAW.

From Saturne workshop; La Londe-les-Maures, France (10 Nov 1986).

This paper presents briefly the theoretical reasons of the study of ultra-relativistic heavy ion collisions (Elab/A >— 1 Tev) (deconfinement transition of hadronic matter, quark-gluon plasma), the hydrodynamic model of the reaction dynamics and the experimental works being carried out or planned in this field. 26 references.

2408 **(CEA-CONF—8875) Probe specificity.** Laget, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Nov 1986. 14p. (In French). (CEA-DPH-N-S—2405; CONF-8611138—7). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752917/JAW.

From Saturne workshop; La Londe-les-Maures, France (10 Nov 1986).

Specificity and complementarity of hadron and electron probes must be systematically developed to answer three questions currently asked in intermediate energy nuclear physics: what is nucleus structure at short distances, what is nature of short range correlations, what is three body force nature.

2409 **(CEA-CONF—8876) Future orientation of intermediate energy physics with electromagnetic probes.** Gerard, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie). Nov 1986. 10p. (In French). (CEA-DPH-N-S—2405B; CONF-8611138—8). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752918/JAW.

From Saturne workshop; La Londe-les-Maures, France (10 Nov 1986).

Some important questions for intermediate energy future are asked: element hadron structure, nuclear force, nucleus structure at short distance, nuclear matter effect on baryon structure. Specificity of electromagnetic probes is discussed. The broad research axes with the future electron machines are presented: elastic scattering, quasi-elastic scattering, nucleon resonance excitation in nucleus, strange nuclear system production, transition towards deep inelastic scattering region.

2410 **(CEA-CONF—8962) From QCD to hadron and nuclear physics.** Chemtob, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Feb 1987. 14p. (CEA-SPhT—87-24; CONF-8702101—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752767/JAW.

From Workshop on intermediate energies: short-range nuclear physics; Orsay, France (11 Feb 1987).

We discuss those aspects of QCD that nourish the hope of finding quark effects in nuclei. The sum rules method in QCD is examined in conjunction with the Fock space method of Brodsky-Lepage with respect to a phenomenology of the hadrons form factors at all transfers. We connect the physics of hadrons in nuclei to the relativistic description of nuclear structure and that of quarks in nuclei to the quark cluster models.

2411 **(CERN-EP—87-131) Laser spectroscopy and nuclear structure.** Stroke, H.H. (European Organization for Nuclear Research, Geneva (Switzerland); New York Univ., NY (USA). Dept. of Physics). 27 Jul 1987. 20p. (CONF-8708149—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900037/JAW.

From 4. international school on laser applications in physics; Vilnius, USSR (22 Aug 1987).

Aspects of nuclear structure studies are discussed in which atomic spectroscopy plays an important part. The experimental techniques span radiofrequency spectroscopy, in particular atomic beam magnetic resonance (ABMR), dispersive or interference spectroscopy, such as with diffraction gratings and Fabry Perot interferometers, and finally tunable lasers, which have allowed impressive gains in precision and sensitivity. The latter quality has been crucial in extending the possible experiments to quite short-lived radioactive atoms. Though ABMR and spectroscopic experiments without lasers have been done with radioactive atoms with lifetimes as short as several minutes for nearly four decades, apart from a few relatively short series that we initiated there were no large scale systematic experiments that span the regions from stable into those of much shorter lived isotopes. 39 refs.

2412 **(CONF-8706193—3) Superdeformed nuclei: Shells-vs-liquid drop, pairing-vs-thermal excitations, triaxial-vs-octupole shapes, super-superdeformation.** Dudek, J. (Joint Inst. for Heavy Ion Research, Oak Ridge, TN (USA); Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1987. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014782/JAW.

From International conference on nuclear shapes; Crete, Greece (28 Jun 1987).

Mechanisms influencing the behavior of superdeformed nuclei are studied using several well established nuclear structure techniques. In particular: pairing, thermal excitation, shell and liquid-drop mechanisms are considered. The effects of quadrupole and hexadecapole (both axial and non-axial), and octupole deformation degrees of freedom are studied. Most of the results are illustrated using the case of ^{153}Dy nucleus in which a superdeformed band extending up to I $\sim$ 60 h-bar has been found in experiment. Some comparisons between ^{153}Dy and the nuclei in the neighborhood are given. Calculations show that pairing "de-aligns" typically 6 to 8 units of angular momentum, as compared to the corresponding rigid rotation. This takes place for spins extending up to the highest limit, and thus diminishes the effective moments of inertia. Predicted octupole shape susceptibility is extremely large, significantly stronger than the susceptibilities known in the ground-states of many Actinide nuclei. Consequences of this result for the near-constancy of the dynamical moments of inertia are pointed out. Nuclear level densities calculated in function of spin, excitation energy and deformation explain the "unusual" side feeding pattern of the ^{153}Dy superdeformed states. Predictions of super-superdeformed nuclear states (axis ratio varying between 2:1 and 3:1 or more) are given and exemplified for Erbium nuclei. Finally, the problem of superdeformation stability and the influence of increased collective inertia on a barrier penetration are examined. An analytical expression for the effective inertia parameter is obtained and its derivation outlined. 35 refs., 9 figs.

2413 **(DL/NUC/P—239T) On the basic assumptions, experimental verification, and interpretation of a new alpha-cluster model.** Daley, H.J. (Daresbury Lab. (UK)). Aug 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900035/JAW.

The basic assumptions made in applying the α-cluster nuclear vibron model to actinide and rare earth nuclei are discussed in this article. It is argued that there is experimental support for those assumptions and additional experimental tests of the model are suggested. 18 refs., 2 figs.

2414 **(DOE/ER/40114—T4) Theoretical aspects of electroweak and other interactions in medium-energy nuclear physics: Final progress report.** Mukhopadhyay, N.C. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Physics). 29 Sep 1987. Contract AC02-83ER40114. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001624/JAW.

The contracted project deals with the theory of photo- and electroproduction of mesons from nucleons and nuclei, electromagnetic structure of baryons and search for axions in nuclear and particle physics. The principal investigator has been a member of the CEBAF steering committee on the research on excited baryons.

2415 **(GANIL-P—87-08) Nuclear Landau-Vlasov dynamics.** Gregoire, C.; De, J.N. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Jan 1987. 13p. (CONF-870153—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752715/JAW.

From 25. international winter meeting on nuclear physics; Bormio, Italy (19 Jan 1987).

The respective roles of mean field effects and of residual two-body collisions are investigated for relevant situations in intermediate energy heavy ion reactions. Limitations to fusion are namely the incomplete fusion process with heavy systems and the ineffectual fusion mechanism for light systems. The highly excited nuclei which are formed during incomplete fusion are found with properties close to experimental observations. They carry much less excitations than the desintegration threshold. This threshold is determined higher with account of the residual interaction than in a pure one-body dynamics. In the last section, we discuss also conduction and convection in finite nuclei, in the frame-work of Landau-Vlasov dynamics.

2416 **(GANIL-P—87-10) Semi-classical description of hot zone decay.** De, J.N.; Gregoire, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Mar 1987. 5p. (CONF-8703153—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752717/JAW.

From International workshop on semi-classical and phase-space approaches to the dynamics of the nucleus; Aussois, France (16 Mar 1987).

The decay of a sharp-surface hot zone, if formed in nuclear collisions, is studied in classical energy-transport model and in the semi-classical VUU framework. Convection is dominant. Global thermalization takes a relatively long time, a few 10/sup -21/ sec. Being at variance with recent experimental data, this feature casts doubt on sharp hot-zone formation as an intermediate state for excitation in finite nuclei in nuclear collisions. 4 figs; 5 refs..

2417 (GSI—87-27-Prepr.) Hadronic signals for quark gluon plasma formation in relativistic heavy ion collisions. Koch, P.; Greiner, C.; Rentzsch, T.; Rischke, D.; Maruhn, J.A.; Mueller, B.; Stoecker, H.; Greiner, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). May 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753322/JAW.

We follow the hydrodynamical evolution of hadronic matter in relativistic nuclear collisions in order to study hadronic signals for quark gluon plasma formation. In particular, we present nonequilibrium calculations for hadronisation and evolution of strange particles and discuss their usefulness for quark matter diagnostics. Furthermore, we discuss the possibility of multistrange quark droplet formation during the phase transition from quark to hadron matter.

2418 (GSI—87-28-Prepr.) Sharing of excitation energy in dissipative nucleus-nucleus collisions. He Zejun; Rozmej, P.; Wu Jianshi; Noerenberg, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). May 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753288/JAW.

The sharing of the total excitation energy on both fragments in dissipative nucleus-nucleus collisions is studied on the basis of the dissipative diabatic dynamics. Numerical calculations are performed for the systems /sup 98/Mo + /sup 147/Sm and /sup 98/Mo + /sup 238/U. In agreement with experimental results the excitation energy per particle is larger for the lighter fragment and increases with increasing asymmetry of the system. The dependence on the total excitation energy is qualitatively different from that for the one-body dissipation model.

2419 (IFUSP-P—570) Symmetrical representation of the transition matrix. I: formal development. Hussein, M.S.; Marques, G.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Feb 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703685/JAW.

An expression for the scattering T-matrix which is symmetrical with respect to the outgoing and ingoing wave functions is derived. The elastic matrix element <K chemical bondTchemical bond K> is obtained from the scaled potential λ V. Several examples are worked out, and application to neutron-nucleus scattering is made.

2420 (IFUSP-P—586) Inertial parameters in the interacting boson fermion approximation. Dukelsky, J.; Lima, C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jun 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703687/JAW.

The Hartree-Bose-Fermi and the adiabatic approximations are used to derive analytic formulas for the moment of inertia and the decoupling parameter of the interacting boson fermion approximation for deformed systems. These formulas are applied to the SU(3) dynamical symmetry, obtaining perfect agreement with the exact results. (Authors).

2421 (IFUSP-P—601) Unitarity defect of the S-matrix and statistical multistep direct nuclear processes. Hussein, M.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703689/JAW.

A relation is derived which connects the unitarity defect function S/sup +/S-1 with the imaginary part of the absorptive potential reaponsible for the nuclear scattering. The concept of angle-dependent reaction cross-section is introduced for the purpose. A similar relation is also obtained for the equivalent quantity S/sup +/-S/sup -1/. Several applications to nucler scattering are made, and possible relevance of this unitarity defect relation to statistical coupled channels theories of preequilibrium reactions is pointed out and discussed.

2422 (INIS-BR—716) Estimation of PHI (γ,n) average probability for complex nuclei in the quasi-deuteron region. Ferreira, M.C.daS. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1977. 127p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703468/JAW.

The average probabilities of (γ,n) reactions for complexe nuclei of /sub 6/C/sup 12/,/sub 19/F/sup 19/, /sub 25/Mn/sup 55/, /sub 79/Au/sup 197/ and /sub 92/U/sup 238/, in the energy range from giant resonance end to photomesonic threshold (quasi-deuteron region), using values of cross sections per quantum equivalent to 300 Mev produced by Bremsstrahlung photons in the Frascati and Orsay accelerators were determined. The probabilities were also calculated using nuclear transparence for protons and neutrons, resultants from quasi-deuteron disintegration. The transparence formulaes were determined by optical model. (M.C.K.).

2423 (INIS-BR—723) Statistical analysis of angular correlation measurements. Oliveira, R.A.A.M. de. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1986. 155p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87703475/JAW.

Obtaining the multipole mixing ratio, δ, of γ transitions in angular correlation measurements is a statistical problem characterized by the small number of angles in which the observation is made and by the limited statistic of counting, α. The inexistence of a sufficient statistics for the estimator of δ, is shown. Three different estimators for δ were constructed and their properties of consistency, bias and efficiency were tested. Tests were also performed in experimental results obtained in γ-γ directional correlation measurements.

2424 (INIS-BR—727) High mass asymmetry in spontaneous and induced desintegration of heavy nuclei. Tavares, O.A.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1978. 123p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703479/JAW.

The experimental and theoretical results related to a new rupture mode of heavy ions (A>230) in mass fragments more different than ordinary ission products, are presented and disussed. Experiences of long exposure time by nuclear emulsion technique, show that, the U/sup 238/ is also a spontaneous emitter of ions with mass number between 20 and 70. The results are interpreted as a high mass asymmetry in fission process or as a nucleon cluster emission mechanism by potential barrier penetration. Preliminary estimation show good agreement with experimental results for U/sup 238/. Glass laminas with uranium thin films prepared 16 years ago, are also analysed aiming to confirm these results. Several experiences with nuclear emulsions and mica sandwich, and radiochemical data show to be possible heavy ion emission from U/sup 238/ induced by photons of low energy as well as neutrons of reactor (M.C.K.).

2425 (INIS-BR—810) Average Nuclear properties based on statistical model. El-Jaick, L.J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1974. 78p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703708/JAW.

The rough properties of nuclei were investigated by statistical model, in systems with the same and different number of protons and neutrons, separately, considering the Coulomb energy in the last system. Some average nuclear properties were calculated based on the energy density of nuclear matter, from Weizsscker-Beth mass semiempiric formulae, generalized for compressible nuclei. In the study of a/sub s/ surface energy coefficient, the great influence exercised by Coulomb energy and nuclear compressibility was verified. For a good adjust of beta stability lines and mass excess, the surface symmetry energy were established. (M.C.K.).

2426 (INIS-BR—812) Semi-empiric study of the shell effect in nuclear mass. Araujo, M.N.S. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1977. 109p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703710/JAW.

A new formula for shell function, studying nuclear mass behavior and shell effect is proposed. The formula takes in account the effects of nuclear structure on the energy spectra. The effect of incomplete energy level coupling resultant from not totally degenerated spectra is considered. The discretized spectrum using Fermi distribution is defined. The intensities of group constants are generalized by expansion of liquid drop model parameters, which describes the macroscopic nuclear structure. (M.C.K.).

2427 **(INIS-BR—813) Dynamic treatment of fission and fusion in two dimensions.** Nazareth, R.A.M.S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1977. 112p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703711/JAW.

The barrier penetrability in two dimensions for nuclear fusion and fission phenomena is studied. The equations of fission static trajectories (minimum potential) in Hofmann formalism are derived and the influence of inertia parameters on the penetrability is verified. For fusion case, a realistic potential for exactly penetrability calculation is proposed. The transverse momentum to the fusion and the unidimensional calculation in classical approximation by choose the trajectory which turn into maximum the penetrability are considered. The exact penetrability is compared with calculation in the classical approximation which takes in account the possibility of appearing discontinuity in the barrier along of fusion pathway. (M.C.K.).

2428 **(INIS-BR—814) Giant dipole resonance by many levels theory.** Mondaini, R.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1977. 81p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703712/JAW.

The many levels theory is applied to photonuclear effect, in particular, in giant dipole resonance. A review about photonuclear dipole absorption, comparing with atomic case is done. The derivation of sum rules; their modifications by introduction of the concepts of effective charges and mass and the Siegert theorem. The experimental distributions are compared with results obtained by curve adjustment. (M.C.K.).

2429 **(INIS-mf—10978) Quasi deuteron model for low energy pion absorption.** Gouweloos, M. (Vrije Univ., Amsterdam (Netherlands)). 15 Dec 1986. 145p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703566/JAW.

In this thesis pion absorption in complex nuclei is studied in the quasi-deuteron model in which the pion is absorbed on a nucleon pair in the nucleus. The mechanism is studied in the low-energy domain since then the in-medium (pi->NN) operator turns out to be of simple character. In Ch. 2 and 3 this operator is constructed and analytical expressions are derived for (pi,NN) distributions in a plane wave impulse approximation for nuclei. The results turn out to be very useful for developing insight in the possibilities inherent in the QDM and the interpretation of the results in later chapters. Ch. 4 to 6 are devoted to the more realistic distorted wave calculations. In Ch. 4 the formal framework is presented and the calculational details are discussed. Ch.5 and 6 contain the comparison to stopped pion and in-flight data respectively. In Ch. 7 the main results are summarized. (Auth.). Includes Dutch summary; 142 refs.; 26 figs.; 10 tabs.

2430 **(INIS-mf—10984) Microscopic description of inelastic proton scattering from /sup 88/Sr.** Kouw, L.R. (Vrije Univ., Amsterdam (Netherlands)). 26 Feb 1987. 105p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703571/JAW.

A microscopic description of the /sup 88/Sr(p,p') reaction at 25 and 31 MeV, 200 MeV and 65 MeV is given. In the analysis several excited states are considered. For the nuclear structure of these states wave functions calculated from a one broken-pair model in a 4hw model space are used which give in general a good description of the shape of the transition charge and current densities as measured in (e,e') scattering. Also a macroscopic analysis has been made of some collective transitions. For 24, 31 and 65 MeV the effective HJ and the JLM interaction were employed, the effective Paris interaction was used at 200 MeV and the M3YP interaction at 65 MeV. At 65 and 200 MeV some calibration factors were needed. It is shown that the nonlocality of the distortion potential is closely related to the nonlocality of the transition potential. The influence of a spin-orbit potential and nonlocality in the single-particle potential on the electromagnetic current operator is discussed. In an impulse approximation of the electromagnetic coupling the presence of these terms would lead to violation of charge conservation. Starting from a Lagrangian formulation a current operator is derived that conserves explicitly electric charge. (Auth.). Includes Dutch summary

2431 (INIS-SU—414, pp 13-18) **Elastic e/sup 3/H scattering and the tritium quark structure.** Burov, V.V.; Luk'yanov, V.K.; Martines, R. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics; Moskovskij Gosudarstvennyj Univ., USSR). 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780009/JAW. (JINR-N—15-86).

In JINR rapid communications. Collection.

It is shown that the elastic e/sup 3/H scattering form factor can be explained within the model allowing for a six- and nine-quark admixture to the tritium wave function with the parameters obtained from the analysis of the /sup 3/He form factor. In this case the interference of nucleon and multiquark channels is very important. The six- and nine-quark admixture probabilities were found to be about 15.4% and 0.54%, and the corresponding contributions to the form factor are 2% and 0.01%. 9 refs.; 3 figs.

2432 (INIS-SU—414, pp 5-12) **Resonance singularities in the two-nucleon system produced in the p/sup 4/He interaction.** Dolidze, M.G.; Lykasov, G.I. (Tbilisskij Gosudarstvennyj Univ., USSR; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Computing Techniques and Automation). 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780009/JAW. (JINR-N—15-86).

In JINR rapid communications. Collection.

The spectrum of effective masses m/sub pp/ of two protons produced in the p/sup 4/He -> nppd process is analysed. It is shown that the maximum at m/sub pp/ — 2.02 GeV/c/sup 2/ can appear in this spectrum due to the one pion exchange mechanism if to suppose that the amplitude of the virtual π-meson absorption on deuteron has the singularity near the threshold of πd -> NN reaction. The mechanism of the second maximum formation at m/sub pp/ — 2.14 GeV/c/sup 2/ in the m/sub pp/-spectrum and the connection of the considered resonance maxima with the possible dibaryon resonance states are discussed. 17 refs.; 5 figs.

2433 (INIS-SU—424, pp 25-29) **Elastic scattering of electrons at large momentum transfer and the quark structure of /sup 4/He.** Burov, V.V.; Luk'yanov, V.K.; Martines, R. 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780011/JAW. (JINR-N—18-86).

In JINR rapid communications. Collection.

The /sup 4/He form factor is investigated within the model where the wave function includes both the nucleon and multiquark admixtures. It is shown that to explain experimental data, one needs 18% of the 6q-admixture and 1% of the 9q one. An estimation is done for the 12q-admixture of the level 0.02%. Contributions of the 6q-, 9q- and 12q-form factors are smaller because of interference of the nucleon and quark channels and their values are 7, 0.8 and 0.01%, respectively. 8 refs.; 3 figs.

2434 (INIS-SU—424, pp 30-36) **Spin-orbit effects in resonance and potential scattering of p-wave neutrons.** Popov, A.B.; Samosvat, G.S. 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780011/JAW. (JINR-N—18-86).

In JINR rapid communications. Collection.

The reported strength functions and parameters R/sub 0//sup ∞/ and R/sub 1//sup ∞/ for s-wave and p-wave neutrons have been obtained from a new type analysis of differential elastic scattering cross sections. The table summarizes S/sub 1//sup 0/, S/sub 1/2//sup 1/, S/sub 3/2//sup 1/, R/sub 0//sup ∞/ and R/sub 1//sup ∞/ for 33 nuclei in the range $48 \leq A \leq 144$. The values of S/sup 0/, S/sup 1/ and R'/sub 0/ do not contradict with the rec-

ommended data from Neutron Cross Sections by Mughabghab et al. The value of S/sub 1/2//sup 1/ and S/sub 3/2//sup 1/ confirm the spin-orbital splitting of the 3p-maximum of the neutron strength function. By using the polarization data there is demostrated that in potential scattering of p-wave neutrons the spin-orbit effect is also present which is in qualitative agreement with experimental splitting of strength functions. 36 refs.; 5 figs.

2435 **(INPE—3739) Iterative inversion of gamma or alpha spectrometry data.** Nordemann, D.J.R. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Dec 1985. 19p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703580/JAW.

Gamma- and alpha-ray spectrometry data are processed by an iterative regression method (Wolberg, 1967) to obtain the activities or yields of radionuclides. This method, applied to Nuclear Geophysics Research, permits the use of either selected energy bands or of all the channels one by one. It may be easily programmed in popular microcomputers and offers many advantages such as the use of mixtures of radionuclides for the calibrations and the treatment of the uncertainties on the measurements and results. Several conclusions about the method and options of nuclear data processing are presented.

2436 **(INS—610) Nucleus as a canonical ensemble. 1. Entropy and level density at low temperature.** Sato, Hiroshi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1986. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703586/JAW.

The nuclear thermodynamical quantities at low excitation energy are studied in terms of the temperature dependent antisymmetrized density matrices of many fermions in a harmonic oscillator well. The relationship between this treatment and the conventional shell model is studied. The nuclear level density is formulated and compared with the conventional formula. It is found that characteristic features of nuclear level densities observed experimentally are reproduced. Also the excitation energy dependence of the level density parameter a is found.

2437 **(INS—611) Nucleus as a canonical ensemble. 2. d/p ratio and entropy at high temperature.** Sato, Hiroshi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703587/JAW.

Highly excited nuclear states formed by high energy heavy-ion collisions are studied in terms of the temperature dependent antisymmetrized density matrix of many fermions in a harmonic oscillator well. Particle inclusive spectrum and multiplicity are studied with the density matrix derived. The deuteron formation probability, the coalescence model and the d/pn and d/p ratios are formulated and studied. The relationship between the d/p ratio and the entropy is discussed. It is found that quantities obtained are consistent with those found in high energy heavy-ion collisions.

2438 **(INS—623) Further investigation on temperature. Dependment optical potential and mean free path.** Zhuo, Yizhong; Han, Yin-lu; Wu, Xi-zhen. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750061/JAW.

Optical potentials and mean free paths of nucleons for nuclear matter and finite nuclei at finite temperatures are studied by utilizing effective Skyrme interactions. This work is an extension of our earlier one by including not only polarization but also correlation contributions, and in this way our present results are expected to be valid to nucleon energies between -35 and 60 MeV relative to Fermi energy and to the nuclear temperatures less than 8 MeV.

2439 **(INS—624) Polarization transfer from polarized nuclear spin to μ/sup -/ spin in muonic atom.** Kuno, Yoshitaka; Nagamine, Kanetada; Yamazaki, Toshimitsu. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750062/JAW.

A theoretical study of polarization transfer from an initially-polarized nuclear spin to a μ/sup -/ spin in a muonic atom is given. The switching of the hyperfine interaction at excited muonic states as well as at the ground 1s state is taken into account. The upper state of hyperfine doublet at the muonic 1s state is considered to proceed down to the lower state. It is found that as the hyperfine interaction becomes effective at higher excited muonic orbitals, a less extent of polarization is transferred from the nuclear spin to the μ/sup -/ spin. The theoretical values obtained are compared with the recent experiment of μ/sup -/ repolarization in a polarized /sup 209/Bi target.

2440 **(JAERI-M—87-088) Analysis of the mass formula dependence of spallation product distribution.** Nishida, Takahiko; Nakahara, Yasuaki; Tsutsui, Tsuneo. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750297/JAW.

A new version of a spallation reaction simulation code NUCLEUS has been developed by incorporating the newly revised Uno and Yamada's mass formula. The mass formula dependence of the spallation product distribution has been investigated by comparing the new results with those calculated by the original version which uses the combination of the Cameron's mass formula and the mass table compiled by Wapstra et al. Detailed differences between these two mass formulas are shown in the comparisons of mass excess values. The distributions of spallation products of a uranium target nucleus bombarded by high energy (0.38 - 2.9 GeV) protons have been calculated with the new and original versions of NUCLEUS. The calculated results show that there is no significant discrepancy in the non-fission component of cumulative product yields such as the mass distribution and the number of emitted neutrons but in the fission component Uno and Yamada's mass formula reproduces the measured data obtained from thin foil experiments significantly better, especially in the neutron excess side, than the Cameron's one.

2441 **(KFKI—1987-14/A) Deconfinement transition in anisotropic matter.** Barz, H.W.; Kaempfer, B.; Lukacs, B.; Wolf, G.; Martinas, K. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Mar 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700123/JAW.

Because of nuclear transparency at beam energies relevant to quark plasma formation, the extension of phase equilibrium conditions for interpenetrating pieces of matter is investigated. Applying this thermodynamical formalism to the deconfinement transition, a non-trivial change is found on the phase diagram, due to the relative velocity of the interpenetrating matter elements. 9 refs.; 2 figs.

2442 **(KFKI—1987-19/A) Model for particle emission from a fissioning system.** Milek, B.; Reif, R.; Revai, J. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Apr 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700126/JAW.

The differential emission probability for a neutron emitted in a binary fission process due to non-adiabatic effects in the coupling of the single particle degrees of freedom to the accelerated relative motion of the fragments is investigated wihtin a model, which represents each nucleus by a non-deformed one-term separable potential. The derivation of measurable quantities from the asymptotic solution of the time-dependent Schroedinger equation for the single particle wave function is examined. Numerical calculations were performed for parameter values, which correspond to /sup 252/Cf(sf). The calculated energy spectra and angular distributions of the emitted particles are presented in dependence on the mass asymmetry. 24 refs.; 5 figs.

2443 **(LA-UR—87-2797) Results of recent calculations using realistic potentials.** Friar, J.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 14p. (CONF-8708143—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014769/JAW.

From 11. European conference on few-body physics; Fontevraud, France (31 Aug 1987).

Results of recent calculations for the triton using realistic potentials with strong tensor forces are reviewed, with an emphasis

on progress made using the many different calculational schemes. Several test problems are suggested. 49 refs., 5 figs.

2444 **(LA-UR—87-3206) Monte Carlo analysis of pion absorption.** Gibbs, W.R.; Kaufmann, W.B. (Los Alamos National Lab., NM (USA); Arizona State Univ., Tempe (USA). Dept. of Physics). 1987. Contract W-7405-ENG-36. 11p. (CONF-8708102—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000488/JAW.

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

Recent pion absorption data with the observation of two protons in coincidence have been interpreted to yield a small fraction of absorption on two-nucleon pairs compared with absorption on multinucleon clusters. The present work demonstrates that a considerable broadening of the two-nucleon correlation function, and concurrent reduction of observed events, arises from Fermi motion, nucleon binding, pion scattering before absorption and nucleon scattering after absorption. The width of the calculated pp angular correlation distribution agrees well with that observed experimentally. After correction for these effects in the assumed two-body absorption process we find that there is a residual mechanism which must account for ~30% of the true-absorption events. 12 refs., 1 fig., 4 tabs.

2445 **(LSNN—85-01) Coherent state methods for semi-classical heavy-ion physics.** Remaud, B.; Sebille, F.; Raffray, Y. (Nantes Univ., 44 (France). Lab. de Spectroscopie Nucleaire). 1985. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752722/JAW.

A semi-classical model of many fermion systems is developed in view of solving the Vlasov equation; it provides an unified description of both static and dynamic properties of the system. The phase space distribution functions are written as convolution products of generalized coherent state distributions with semi-probabilistic weight functions. The generalized coherent states are defined from the local constants of motion of the dynamical system; they may reduce to the usuel ones (eigen states of the annihilation operator) only at the harmonic limit. Solving the Vlasov equation consists in two steps: (i) search for weight functions which properly describe the initial density distributions (ii) calculation of the evolutions of the coherent state set which acts as a moving basis for the Vlasov equation solutions. Sample applications to statics are analyzed: fermions in a harmonic field, self-consistent nuclear slabs. Outlooks of dynamical applications are discussed with a special attention to the fast nucleon emission in heavy-ion reactions.

2446 **(LYCEN—8633) Unified description of πd-πd, πd-NN and NN-NN reactions at intermediate energies.** Lamot, G.H.; Perrot, J.L.; Fayard, C.; Mizutani, T. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Jun 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752719/JAW.

The theory of the coupled π NN-NN systems is applied to the unified description of the πd-πd, πd-NN and NN-NN reactions in the intermediate energy range. Off-shell modifications are introduced in the P/sub 33/ and P/sub 11/ πN channels and the effects of heavy meson exchange are investigated. In general, results for various observables are in agreement with experiments. We have assessed certain aspects upon which future works should improve.

2447 **(SLAC-PUB—4387) Novel nuclear phenomena in quantum chromodynamics.** Brodsky, S.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Aug 1987. Contract AC03-76SF00515. 23p. (CONF-8706166—5). NTIS, PC A02. Order Number DE88000707/JAW.

From International symposium on medium energy physics; Beijing, China (23 Jun 1987).

Many of the key issues in understanding quantum chromodynamics involve processes in nuclear targets at intermediate energies. A range of hadronic and nuclear phenomena-exclusive processes, color transparency, hidden color degrees of freedom in nuclei, reduced nuclear amplitudes, jet coalescence, formation zone effects, hadron helicity selection rules, spin correlations, higher twist effects, and nuclear diffraction were discussed as tools for probing hadron structure and the propagation of quark and gluon jets in nuclei. Several areas were also reviewed where there has been significant theoretical progress determining the form of hadron and nuclear wave functions, including QCD sum rules, lattice gauge theory, and discretized light-cone quantization. A possible interpretation was also discussed of the large spin correlation A/sub NN/ in proton-proton scattering, and how relate this effect to an energy and angular dependence of color transparency in nuclei. 76 refs., 24 figs.

2448 **Systematic relationship between the centroid and width of the isoscalar giant quadrupole resonance and the neutron binding energy.** Loveman, R.A.; Peterson, R.J. (Colorado Univ., Boulder, USA. Nuclear Physics Lab.). *Zeitschrift fuer Physik A: Atomic Nuclei;* **328**: No. 3, 281-283(Nov 1987).

A simple relationship has been found between the experimentally determined width and centroid of the isoscalar giant quadrupole resonance and the neutron binding energy. We find that the energy difference between the centroid and the binding energy is very nearly proportional to the width. This relationship works with few exceptions throughout the periodic table for nuclei heavier than /sup 40/Ca.

2449 **Interaction of a 10 eV silicon beam with the Si(111) surface: A molecular dynamics study.** Dodson, B.W.; Taylor, P.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Materials Research;* **2**: No. 6, 805-808(Nov 1987). Contract AC04-76DP00789.

The interaction of a low-energy silicon beam with a silicon substrate has been simulated. The combined effects of vibrational lattice excitation and of covalent binding have been included for the first time by using a molecular dynamics technique and an empirical potential that accurately describes the covalent Si—Si interactions. A 10 eV silicon beam was directed normal to a silicon (111) substrate. Sticking ratio, penetration depth, substrate structure, and vibrational excitation of the substrate are quantitatively determined. The special features of such low-energy beam deposition relative to thermal deposition processes are discussed.

2450 **Calculated fission properties of the heaviest elements.** Moeller, P.; Nix, J.R.; Swiatecki, W.J. (Lawrence Livermore National Lab., CA, USA; Los Alamos National Lab., LANL, NM, USA. Theoretical Div.; Lawrence Berkeley Lab., CA, USA. Nuclear Science Div.). *Nuclear Physics [Section] A;* **469**: No. 1, 1-50(20 Jul 1987).

We present a quantitative calculation that shows where high-kinetic-energy symmetric fission occurs and why it is associated with a sudden and large decrease in fission half-lives. We base our study on calculations of potential-energy surfaces in the macroscopic-microscopic model and a semi-empirical model for the nuclear inertia. For the macroscopic part we use a Yukawa-plus-exponential (finite-range) model and for the microscopic part a folded-Yukawa (diffuse-surface) single-particle potential. We use the three-quadratic-surface parameterization to generate the shapes for which the potential-energy surfaces are calculated. The use of this parameterization and the use of the finite-range macroscopic model allows for the study of two touching spheres and similar shapes. Since these shapes are thought to correspond to the scission shapes for the high-kinetic-energy events it is of crucial importance that a continuous sequence of shapes leading from the nuclear ground state to these configurations can be studied within the framework of the model.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 759, 796, 2248

2451 **(CEA-CONF—8950) Deterministic particle method for convection diffusion equation.** Hermeline, F.; Besnard, D. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 12p. (CONF-8702100—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752756/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

Particle methods are well suited for solving transport equations. We generalize this technique to transport-diffusion equations. The treatment of the diffusion term is based upon its reinterpretation as a nonlinear convection term. The numerical solution of the Heat Diffusion Equation is compared with the corresponding exact solution. Its stability as a function of particle size and time step is studied. This method is then applied to the Fokker Planck Equation specialized to fast-ions transport.

2452 **(CEA-CONF—8956) Multigroup direct methods for solving radiative transfer equations.** Sentis, R. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 12p. (CONF-8702100—9). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752762/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

The aim of this paper is the numerical treatment of the non linear terms of the radiative transfer equations. Of course we consider here only the simplest form of these equations, that is to say without taking into account hydrodynamic terms, Compton or Thomson scattering terms. Provided the radiative transfer equations are transport equations, we consider here the diffusion form of these equations, so called multigroup diffusion equations, (of course these equations are coupled with a non linear energy balance equation). The scheme is described first; afterwards it is analysed in the case of the opaque limit. Then this scheme is compared with another one which is based on a quite different linearization and numerical results are given.

2453 **(CONF-8708117—4) Magnetic diffuse scattering.** Cable, J.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013539/JAW.

From Neutron scattering symposium on advances and applications; Sydney, Australia (8 Aug 1987).

The diffuse scattering of neutrons from magnetic materials provides unique and important information regarding the spatial correlations of the atoms and the spins. Such measurements have been extensively applied to magnetically ordered systems, such as the ferromagnetic binary alloys, for which the observed correlations describe the magnetic moment fluctuations associated with local environment effects. With the advent of polarization analysis, these techniques are increasingly being applied to study disordered paramagnetic systems such as the spin-glasses and the diluted magnetic semiconductors. The spin-pair correlations obtained are essential in understanding the exchange interactions of such systems. In this paper, we describe recent neutron diffuse scattering results on the atom-pair and spin-pair correlations in some of these disordered magnetic systems. 56 refs.

2454 **(DP-MS—87-53) The separability approximation and its application to S/sub n/.** Clark, H.K. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 25p. (CONF-871101—63). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000796/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

Although nuclear criticality safety analyses are commonly done now by a Monte Carlo computer code such as KENO, one-dimensional determinate methods still have an important role. The usefulness of these methods is greatly enhanced where separability of the neutron flux into axial and radial components is a good approximation. Although the flux in a reflected reactor is not separable, the infinite medium solution which is approached within a finite core far from boundaries is separable. For a finite, reflected cylindrical reactor, a reasonable approach is to calculate the flux in the axial direction by assuming a radial flux shape J_0 (B/sub r/r) everywhere and in the radial direction by assuming an axial shape cos (B/sub z/z) everywhere. The transverse bucklings B/sub r/^{2} and B/sub z/^{2} are determined in the axial and radial calculations to correspond to a specified value of k/sub eff/, usually unity initially. The geometric bucklings in the axial and radial directions are then obtained by subtracting each transverse buckling from the infinite medium buckling calculated from cross sections at this value of k/sub eff/. From the cross sections and the sum of the geometric bucklings, k/sub eff/ is calculated. If the value obtained differs from that originally specified, iteration is required but convergence is rapid. To test the procedure, calculations were done for a range of small water-reflected cylinders of $^{233}UO_2F_2$ solution containing 400 g ^{233}U/L calculated by TWOTRAN to be critical. The procedure worked well for this system.

2455 **(LA-UR—87-2534) Theory of neutron scattering experiments on momentum distributions in quantum fluids.** Silver, R.N. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 13p. (CONF-8707110—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE87013169/JAW.

From 11. international workshop on condensed matter theories; Oulu, Finland (27 Jul 1987).

In this paper, the first perturbative derivation of the final state corrections to the impulse approximation for deep inelastic neutron scattering experiments was presented. The final state broadening is found to depend on g(r) and the He-He phase shifts. The theory satisfies the f-sum rule, the ω^2 sum rule ("kinetic energy") valid at high Q, and the ω^3 sum rule. In the structure of the theory, the self-energy terms alone would lead to quasi-Lorentzian broadening. However, these are exactly canceled by a part of the vertex terms which introduce g(r). Numerical results are presented for superfluid ^{4}He.

2456 **(LA-UR—87-2898) New opportunities in neutron capture research using advanced pulsed neutron sources.** Bowman, C.D. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 24p. (CONF-8708101—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000518/JAW.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

The extraordinary neutron intensities available from the new spallation pulsed neutron sources open up exciting opportunities for basic and applied research in neutron nuclear physics. Prospective experiments are reviewed with particular attention to those with a strong connection to capture gamma-ray spectroscopy.

2457 **(LYCEN—8618) Experimental study of pair creation and radiation in Ge crystals at ultrarelativistic energies (30-200 GeV).** Belkacem, A.; Chevallier, M.; Bologna, G. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Apr 1986. 10p. (CONF-8603114—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752709/JAW.

From Workshop on relativistic channeling Acquafredda di Maratea; Maratea, Italy (31 Mar 1986).

The aim of this paper is to present and discuss recent studies performed at CERN (NA 33 collaboration) on the pair creation rate of high energy photons and on the radiation of high energy electrons and positrons in germanium crystals. Our previous measurements have already been published /sup 11-13/. We observed that the pair production rate for photons aligned with the $< 110 >$ axial direction of a Ge crystal increases rapidly with energy, in good agreement with the theoretical predictions, and the study of the tilt angle dependence shows that the process does not depend on whether the created charged particles are channeled or not.

2458 **(SAND—87-0408C) Hard error generation by neutron irradiation.** Browning, J.S.; Gover, J.E.; Wrobel, T.F.; Hass, K.J.; Nasby, R.D.; Simpson, R.L.; Posey, L.D.; Boos, R.E.; Block, R.C. (Sandia National Labs., Albuquerque, NM (USA); Rensselaer Polytechnic Inst., Troy, NY (USA)). 1987. Contract AC04-76DP00789. 33p. (CONF-870724—11). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87013062/JAW.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

We have observed that neutron-induced fission of uranium contaminants present in alumina ceramic package lids results in the release of fission fragments that can cause hard errors in metal nitride-oxidenonvolatile RAMs (MNOS NVRAMs). Hard error gen-

eration requires the simultaneous presence of (1) a fission fragment with a linear energy transfer (LET) greater than 20 MeV/mg/cm^2 moving at an angle of 30° or less from the electric field in the high-field, gate region of the memory transistor and (2) a WRITE or ERASE voltage on the oxide-nitride transistor gate. In reactor experiments, we observe these hard errors when a ceramic lid is used on both MNOS NVRAMs and polysilicon-nitride-oxide-semiconductor (SNOS) capacitors, but hard errors are not observed when a gold-plated kovar lid is used on the package containing these die. We have mapped the tracks of the fission fragments released from the ceramic lids with a mica track detector and used a Monte Carlo model of fission fragment transport through the ceramic lid to measure the concentration of uranium present in the lids. Our concentration measurements are in excellent agreement with others' measurements of uranium concentration in ceramic lids. Our Monte Carlo analyses also agree closely with our measurements of hard error probability in MNOS NVRAMs. 15 refs., 13 figs., 8 tabs.

2459 **Neutron optics with multilayer monochromators.** Saxena, A.M.; Majkrzak, C.F. (Brookhaven National Lab., Upton, NY). pp 143-157 of Neutrons in biology. Schoenborn, B.P. (ed.). New York, NY; Plenum Publishing Corporation (1984).

A multilayer monochromator is made by depositing thin films of two materials in an alternating sequence on a glass substrate. This makes a multilayer periodic in a direction perpendicular to the plane of the films, with a d-spacing equal to the thickness of one bilayer. Neutrons of wavelength λ incident on a multilayer will be reflected at an angle phi given by the Bragg relation $n\lambda = 2d \sin\phi$, where n is the order of reflection. The use of thin-film multilayers for monochromating neutrons is discussed. Because of the low flux of neutrons, the samples have to be large, and the width of the incident beam can be as much as 2 cm. Multilayers made earlier were fabricated by resistive heating of the materials in a vacuum chamber. Because of geometrical constraints imposed by the size of the vacuum chamber, limits on the amount of material that can be loaded in a boat, and finite life of the boats, this method of preparation limits the length of a multilayer to ~ 15 cm and the total number of bilayers in a multilayer to about 200. This paper discusses a thin-film deposition system using RF sputtering for depositing films.

6550 Medical Physics

REFER ALSO TO CITATION(S) 1503, 1625, 1626, 1632, 1752, 1941

2460 **(GSF—5/87) Calculation of dose from photon exposures using reference human phantoms and Monte Carlo methods. Pt. 5. Organ doses from radiotherapy for cervical cancer.** Petoussi, N.; Zankl, M.; Williams, G.; Veit, R.; Drexler, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). Jan 1987. 136p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87753286/JAW.

There has been some evidence that cervical cancer patients who were treated by radiotherapy, had an increased incidence of second primary cancers noticeable 15 years or more after the radiotherapy. The data suggested that high dose pelvic irradiation was associated with increase in cancers of the bladder, kidneys, rectum, ovaries, corpus uteri, and non-Hodgkin's lymphoma but not leukemia (Kleinerman et al., 1982, Morton 1973). The aim of the present work is to estimate the absorbed dose, due to radiotherapy treatment for cervival cancer, to various organs and tissues in the body. Monte Carlo calculations were performed to calculate the organ absorbed doses resulting from intracavitary sources such as ovoids and applicators filled or loaded with radium, Co-60 and Cs-137. For that purpose a routine which simulates an internal source was constructed and added to the existing Monte Carlo code (GSF-Bericht S-885, Kramer et al.). Calculations were also made for external beam therapy. Various anterior, posterior and lateral fields were applied, resulting from megavoltage, Co-60 and Cs-137 therapy machines. The calculated organ doses are tabulated in three different ways: as organ dose per air Kerma in the reference field, according to the recommendations of the International Commission on Radiation Units and Measurements (ICRU Report No 38, 1985); as organ dose per surface dose and as organ dose per tissue dose at Point B.

2461 **(INIS-BR—720) Calculation of equivalent dose index for electrons from 5.0 to 22.0 MeV by the Monte Carlo method.** Peixoto, J.E. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1979. 63p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87703472/JAW.

The index of equivalent dose in depth and in a sphere surface of a soft tissue equivalent material were determined by Monte Carlo method for electron irradiations from 5.0 to 22.00 MeV. The effect of different irradiation geometries which simulate the incidence of onedirectional opposite rotational and isotropic beams was studied. It is also shown that the detector of wall thickness with 0.5g/cm/sup 2/ and isotropic response com be used to measure index of equivalent dose for fast electrons. The alternative concept of average equivalent dose for radiation protection is discussed. (M.C.K.).

2462 (INIS-mf—11001, pp 85-92) **Instrumentation for NPP personnel monitoring.** Ageev, T.S.; Vasil'ev, S.N.; Efimov, V.I.; Zhernov, V.S.; Kuz'min, V.V.; Minaeva, E.E.; Nelip, V.A.; Sokolov, A.D.; Suchkova, L.A. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Set of special technical devices is considered for NPP personnel monitoring as a part of the radiation safety diagnostic instrumentation (RSDI) complex. It allows to carry out the current and periodical monitoring of chronic and accidental dose commitments. The first experience of the instruments operation has shown them to be convenient tools for NPP perpersonnel monitoring. 12 refs.; 1 tab.

2463 (INIS-mf—11001, pp 119-122) **Systematic processing of the external individual monitoring data obtained by photographic film and capacitor dosemeters.** Krueger, F.; Shtuk, D. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Individual radiation load measurements have been carried out both with photographic film and capacitor type dosemeters (CD). Systematic statistics methods were applied for the obtained data processing. The CD data were shown to exceed those measured with the film dosemeters. Specific features of the CD application are revealed that should be taken into account in practice. 3 figs.

2464 (INIS-mf—11001, pp 123-131) **International and national comparisons of individual monitoring methods in mixed neutronic/gamma radiation fields.** Prouza, Z.; Spurny, F.; Trousil, Ya.; Nikodemova, D. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Comparison results for measuring instruments used for mixed gamma-neutron radiation field studies are presented. The experimental conditions and particular dosemeters are described. Preferable areas for various instruments application and the sources of the measuring data differences have been revealed. The energy spectrum variation has been shown to have the major impact on the measuring data interpretation, especially in the accidental dose interval. 14 refs.; 7 figs.

2465 (INIS-mf—11001, pp 139-152) **Current state and prospects of individual neutron and gamma dosimetry in Czechoslovakia.** Trousil, Ya.; Prouza, Z.; Kokta, L. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A new monitoring system is described that is being introduced into the national individual monitoring service in Czechoslovakia and used also at NPPs. Detailed description is given of a new thermoluminescent dosemeter and method of its energy dependence compensation with the use of a perforated filter, the angular dependence of radiation registration being thus considerably decreased. A new neutron dosemeter is described also consisting of a track detector and foils of fissile materials (enriched uranium and thorium). 8 refs.; 12 figs.

2466 (INIS-mf—11001, pp 153-159) **Investigation of radionuclide removing from organism by means of MMD measurements.** Pul'khajm, K.F. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Investigation results of radionuclide removing from organism are presented for seven men from Greifswald NPP personel. In their bodies manganese-54, cobalt-58 and silver-110 isotopes have been identified for which the effective half-life periods were determined. The inspection lasted from 43 to 149 days. In some cases together with slowly removing radioactivity fast components were detected. Dose commitment measurements have been done. Characteristics of detectors incorporated into the Man monitoring detector (MMD) are given. 2 refs.; 4 tabs.

2467 (INIS-mf—11001, pp 160-162) **Radiophotoluminescence glass dosemeters.** Khristova, M.G.; Marichkova, L.D.; Stefanov, S.G. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Major characteristics of radiophotoluminescence glass dosemeters produced in Bulgaria are given. The testing results show the dosemeter radiophotoluminescence to be constant in time, does not vary with temperature rise up to 150 grad. C and reaches its maximum soon after irradiation. The dosemeters have a slight spectral dependence. 8 refs.; 2 tabs.

2468 (INIS-mf—11001, pp 163-165) **Combined cassette for individual dosimetry.** Khristova, M.G.; Ruskov, I.N. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A combined cassette is described for detailed qualitative and quantitative estimates of the personnel individual dose commitments under various conditions. The cassette of 63x40x10 mm size includes three types of detectors: 1) photo-detector with four areas screened by different shielding layers for beta, gamma and thermal neutron radiation; 2) activation detectors for the thermal neutron absorbed dose measuring in five energy intervals; 3) radiophotoluminescent glass dosemeters for the absorbed dose of gamma and neutron radiation. 1 fig.

2469 (INIS-mf—11001, pp 166-181) **Hygienic requirements to NPP radiation monitoring systems.** Buchina, I.; Malatova, I.; Kunz, Eh.; Shevts, J.; Tomas, J. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The continuous gamma-spectrometry during normal NPP operation is suggested to be replaced by continuous sample picking with the following periodic analysis. For the emergency conditions a telemetric system of the radionuclide releases monitoring has been developed. Such a system allows to get quickly information needed for taking radiation protection measures in case of accidents. The individual body monitoring technique is suggested for NPP personnel, with the use of Ge(Li)-detector. 16 refs.; 7 tabs.; 4 figs.

2470 (INIS-mf—11001, pp 197-207) **Results of Greifswald NPP personnel medical inspections.** Klatt, R. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Results of medical inspections of 332 men from NPP personnel are presented. The inspections were conducted since 1966, twice a year. The obtained data have been treated to reveal the impact of various factors (ionizing radiation, smoking, three-shift work) and their combinations on health, sick rates and on the haematological state of the NPP personnel. 7 tabs.

2471 (JAERI-M—87-081) **Development of realistic chest phantom for calibration of in-vivo plutonium counting facilities.** Shirotani, Takashi. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750053/JAW.

We have developed realistic chest phantom with removable model organs. The phantom is a torso and is terminated just above the femoral region. Tissue equivalent materials used in the phantom have been made of polyurethane with different amounts of ester of phosphoric acid, in order to simulate human soft tissues such as muscle, muscle-adipose mixtures and cartilage. Lung simulant has been made of foamed polyurethane. Capsulized small sources can be inserted into the holes, drilled in each sliced section of the model organ. Counting efficiencies, obtained with a pair of 12 cm diameter phoswich detectors set above the phantom chest, are 0.195 cpm/nCi for Pu-239 and 44.07 cpm/nCi for Am-241, respectively. The results agree well with efficiencies obtained with IAEA-Phantom. We conclude that the phantom can be used as a standard phantom for the calibration of Pu chest counting equipment.

2472 (KURRI-TR—269) **Proceedings of the conference on methods of measurement and evaluation of personnel neutron exposure.** Honda, Y.; Katurayama, K.; Tsujimoto, T. (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 1985. vp. (CONF-8407193—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87780118/JAW.

From Methods of measurement and evaluation of personnel neutron exposure; Kumatori, Osaka, Japan (27 Jul 1984).

Separate abstracts have been prepared for papers from the conference methods of measurement and evaluation of personnel neutron exposure.

2473 (NAC—86-09) **Neutron dosimetry intercomparison between Clatterbridge and NAC (Pretoria).** Hough, J.H. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Accelerator Centre). 1986. 16p. CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa.

An intercomparison of TE chamber responses was undertaken by measuring the total absorbed dose at different depths in a water phantom exposed to the p(65) + Be neutron therapy beam of the MRC Cyclotron at Clatterbridge (UK). The NAC (Pretoria) ionization chamber used in these measurements was calibrated at Clatterbridge using the hospital reference standard. Clatterbridge TE gas and instrumentation were used throughout. To monitor differences in electrometer responses, a pA current source was used to relate the responses of the Clatterbridge and Pretoria electrometers. Differences in the composition of the TE gas mixtures used at the two centres were quantified by means of measurements with and without TE gas. After applying the physical constants proposed in a supplement to the European and American protocols for neutron dosimetry, good agreement for the measured total absorbed dose was obtained.

2474 (PNL—5847) **Beta measurements at Department of Energy facilities.** Rathbun, L.A.; Swinth, K.L.; Haggard, D.L. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87014621/JAW.

Pacific Northwest Laboratory performed a two-step process to characterize the current beta measurement practices at DOE fa-

cilities. PNL issued a survey questionnaire on beta measurement practices to DOE facilities and reported the results. PNL measured beta doses and spectra at seven selected DOE facilities and compared selected measurement techniques in the facility environment. This report documents the results of the radiation field measurements and the comparison of measurement techniques at the seven facilities. Data collected included beta dose and spectral measurements at seven DOE facilities that had high beta-to-gamma ratios (using a silicon surface barrier spectrometer, a plastic scintillator spectrometer, and a multielement beta dosimeter). Other dosimeters and survey meters representative of those used at DOE facilities or under development were also used for comparison. Field spectra were obtained under two distinct conditions. Silicon- and scintillation-based spectrometer systems were used under laboratory conditions where high beta-to-gamma dose ratios made the beta spectra easier to observe and analyze. In the second case, beta spectrometers were taken into actual production and maintenance areas of DOE facilities. Analyses of beta and gamma spectra showed that ^{234}Th- /sup 234m/Pa, ^{231}Th, ^{137}Cs, and ^{90}Sr/^{90}Y were the major nuclides contributing to beta doses at the facilities visited. Beta doses from other fission products and ^{60}Co were also measured, but the potential for exposure was less significant. 21 refs., 64 figs., 18 tabs.

2475 **(RERF-TR—9-86) Dental radiography exposure of the Hiroshima and Nagasaki populations.** Antoku, Shigetoshi; Hoshi, Masaharu; Russell, W.J. (Radiation Effects Research Foundation, Hiroshima (Japan)). Apr 1987. 11p. (In Japanese and English). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750291/JAW.

Dental radiography doses in Hiroshima and Nagasaki were estimated using doses measured by a thermoluminescent dosimeter and a phantom, and survey data from dental hospitals and clinics in Hiroshima and Nagasaki. Doses to organs, including the lens, pituitary fossa, thyroid gland, and skin were calculated. Average doses per examination to these body sites were calculated using data obtained during a two-week survey in both cities. The mean caput doses were calculated from the data indicating frequency per year, and were tabulated by organ, age, teeth examined, type of examination, population, sex, and city. No significant difference was observed by age, population, sex, or city. Currently, the doses incurred during dental radiography may not be sufficiently high to cause bias in the assessments for late radiation effects among atomic bomb survivors. However, the mean caput thyroid doses of 62 mrad and 67 mrad in Hiroshima and Nagasaki, respectively, cannot be ignored from the standpoint of their potential in contributing to radiation-induced carcinogenesis.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 796, 1160, 1227, 1256, 2108, 2333, 2342, 2455

2476 **(AD-A—183167/6/XAB) Inelastic ion-surface collisions. Technical report.** Rabalais, J.W. (Houston Univ., TX (USA). Dept. of Chemistry). 15 May 1987. 19p. (SCIENTIFIC—1). NTIS, PC A02/MF A01.

Ion scattering and direct recoil spectrometries were used to investigate electronic excitation and charge-transfer processes occuring during rare-gas-ion bombardment of CuLi alloy. Excitations in the close encounter appear to be governed by the degree of inner shell mixing between the colliding pair. Excitations in the outgoing trajectory are governed by the probabilities of Auger and resonant charge exchange between the scattered or recoiled particle and the surface. Measurements of the vacuum-ultraviolet photon emission of the scattered and recoiled particles proved to be unsuccessful due to low photon yields. The ion induced surface damage to transition-metal fluoroanions was investigated by XPS and UPS. Ion bombardment reduces the transition-metal atom to lower oxidation states, in some cases all the way to the metal. These results are consistant with the thermal spike model of ion damage.

2477 **(AD-A—183263/3/XAB) Selective reactive ion etching of tungsten films in fluorinated gases. Technical report.** Pan, W.S.; Steckl, A.J. (Rensselaer Polytechnic Inst., Troy, NY (USA). Center for Integrated Electronics). Jul 1987. 34p. (RPI/CIE/TR—16). NTIS, PC A03/MF A01.

The use of reactive ion etching (RIE) with fluorinated gas plasmas, such as SF_6, CHF_3 and CF_4 mixed with oxygen, to achieve selective patterning of tungsten films is reported. Rapid thermal annealing (RTA) was used to improve the properties of sputtered films. The resistivity of W films was found to decrease rapidly with annealing time (within 10 sec) and to exhibit an Arrhenius behaviour with annealing temperature. The etch rates of W, Si, and SiO_2 were measured as a function of oxygen percentage in the fluorinated gas plasma. The results on optimum selectivity indicate that a CHF_3/70%O mixture results in W:Si and W:SiO_2 etch rate ratios of 2.4:1 and 2.1:1 for unannealed W films, and 1.6:1 and 1.8:1 for annealed samples, respectively. A higher W etch rate selectivity over SiO_2 was obtained in an SF_6/ 5% O_2 plasma where the etch rate ratio is 11.6:1 for unannealed W films and 3:1 for annealed W samples. For reverse selectivity, the optimum W:SiO_2 etch rate ratios measured are 1:7.7 in pure CHF_3 gas for unannealed W and 1:4.6 for annealed W. The optimum W:Si reverse selectivity of 1:10 is obtained with an SF_6/30%O_2 mixture plasma for both annealed and unannealed films. Satisfactory anisotropic edge profiles were obtained with CHF_3 /70%O_2 and SF_6/5%O_2 where vertical-to-later etch ratios of 3.5:1 and 2:1 were measured.

2478 **(AD-A—183354/0/XAB) Adsorption of H_2 and D_2 on Fe(110). 1. Helium scattering as a probe of adsorption. Interim report.** Kurz, E.A.; Hudson, J.B. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). 30 Jul 1987. 33p. (TR—2). NTIS, PC A03/MF A01.

Results of thermal-energy atom scattering (TEAS) measurements of hydrogen and deuterium adsorption-desorption kinetics on iron (110) are presented in detail, with emphasis on the strength and pitfalls inherent in this recently developed technique. It is shown that, for this system, adlayer coverage is directly related to the height of the specularly scattered peak from an incident helium atomic or deuterium molecular beam. The scattered peak height was used to monitor surface concentration as adsorption or desorption occurred, and at equilibrium. Measurements were carried out both at constant temperatures and during temperature programmed desorption. The cross sections for helium scattering from deuterium and hydrogen on Iron (110) were found to be 3.4 A squared and 3.5 A squared, respectively. The cross section for D_2 scattering from adsorbed deuterium on Fe(110) was measured as 11.0 A squared. The initial sticking coefficient and the rate of adsorption were found to be independent of temperature for both H_2 and D_2. The desorption kinetics were found to be second order, with activation energies of 26.5 kcal/mole (D_2) and 25.0 kcal/mole (H_2). The isosteric heats of adsorption are 24.7 kcal/mole (D_2) and 24.2 kcal/mole (H_2).

2479 **(AD-A—183356/5/XAB) Influence of desorption kinetics on hydrogen permeation in iron. Interim report.** Arbab, M.; Hudson, J.B. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). 30 Jul 1987. 41p. (TR—1). NTIS, PC A03/MF A01.

The common observation that the diffusivity of hydrogen in iron decreases anomalously at low temperatures is treated in terms of the barrier to atom recombination and desorption that is known to be associated with the surfaces of this metal. Results obtained are in good agreement with both data on deuterium permeation through a polycrystalline iron sample, obtained in this study, and with the body of measurements for hydrogen diffusion through iron found in the literature.

2480 **(CBPF-NF—022/86) Influence of the interaction anisotropy on the appearence of surface magnetism.** Mariz, A.M.; Costa, U.M.S.; Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703671/JAW.

The phase diagram of the semi-infinite anisotropic Heinsenberg ferromagnet, with surface (bulk) coupling constant J/sub s/ (J/sub B/) and anisotropy eta/sub s/ (eta/sub B/), within a simple real space renormalization group scheme is studied. The eta/sub s/ and eta/sub B/ effects on the (multicritical) ratio J/sub s//J/sub B/ above which surface order becomes observable even if bulk order is absent. Enhancement occurs for an Ising-like free surface (eta/sub s/ — =1) on top of an isotropic-Heisenberg-like bulk (eta/sub B/ — =0).

2481 **(CBPF-NF—051/86) /sup 59/Co NMR and nuclear magnetic relaxation study of the magnetic superconductor Y/sub 9/Co/sub 7/.** Figiel, H.; Barata, A.C.; Guimaraes, A.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703673/JAW.

The magnetic superconductor Y/sub 9/Co/sub 7/ presented in its structure magnetic and non-magnetic Co atoms. A search was made of the /sup 59/Co NMR lines attributed in the literature to magnetic Co atoms, With negative results. For the strong /sup 59/Co NMR line arising from nuclei of non-magnetic Co atoms the relaxation times T/sub 1/ and T/sub 2/ versus temperature were measured directly at 6.5 MHz and 9.0 MHz. A linear dependence on temperature was observed for 1/T/sub 1/ which can be attributed to interactions with conduction electrons. 1/T/sub 2/ is not linear with temperature, an effect that is related to the temperature dependence of the magnetization. (Authors).

2482 **(CONF-8709135—2) Convoy electrons in coincidence with outgoing charge states of Ni (920 MeV).** Kemmler, J.; Heil, O.; Biedermann, C.; Koschar, P.; Rothard, H.; Kroneberger, K.; Groeneveld, K.O.; Sellin, I.A. (Oak Ridge National Lab., TN (USA); Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik; Tennessee Univ., Knoxville (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02. Order Number DE87014944/JAW.

From 14. international conference on X-ray and inner-shell processes; Paris, France (14 Sep 1987).

We have studied the target thickness (rho x) dependence of the convoy electron yield Y/sub e/(q/sub f/) for the incident projectiles of nickel ions (charge q/sub i/$^{+}$) (15.6 MeV/u) with q/sub i/ = 28 and 27 on carbon foils in coincidence with outgoing projectiles with charge q/sub f/ = 28 and 27. Simultaneously the charge state evolution F(q/sub f/, rho x) dependence on the incident charge q/sub i/ has been measured. For this collision system the charge state distribution equilibrates for target thicknesses > 650 $\mu g/cm^2$. In the framework of a model for convoy electron production the rho x dependence of the yield Y/sub e/ (q/sub i/,q/sub f/) can be explained if one introduces and electron transport length λ/sub c/ which is much larger than the attenuation length λ/sub e/ of free electrons.

2483 **(DOE/ER/45282—7) The finite element method for electronic structure.** White, S.R.; Wilkins, J.W.; Teter, M.P. (Cornell Univ., Ithaca, NY (USA). Lab. of Atomic and Solid State Physics; Corning Glass Works, NY (USA)). 31 Aug 1987. Contract FG02-86ER45282. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001708/JAW.

We discuss the use of the finite element method in electronic structure calculations. Products of orthogonal or nonorthogonal 1-D finite element shape functions are used to form 3-D basis functions on a cubic grid. The strict locality of these functions means that the matrix for any local operator is very sparse, making calculation times proportional to the number of basis functions N possible. The completeness of the basis can be increased globally by decreasing the grid spacing and locally by increasing the number of basis functions per site. We discuss algorithms, including the highly efficient multigrid method, for solving the Poisson equation and for the ground state of the single particle Schroedinger equation in O(N) time. Results are presented for test calculations of H, H_2^+, He, and H_2 using as many as 500,000 basis functions. 21 refs.

2484 **(INIS-BR—700) Dynamic of Ising model with transverse field for two coupled sublattices in disordered phase.** Sa Motta, C.E.H. de. (Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Fisica). Feb 1984. 84p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703460/JAW.

The dynamics of the two coupled sublattices tridimensional Ising model in a transverse field was studied by means of a continued fraction expansion for coupled operators. The static Correlation Functions necessary for studying the dynamics were calculated with the Green's Functions Method in the Random Phase Approximation (RPA). The spectral function was calculated in the region T/sub c/ < T < ∞ for some values of the Hamiltonian parameters and the wave vector q/sup ->/.

2485 **(INIS-BR—748) Proceedings of the 9. National Meeting on Condensed Matter Physics.** (Sociedade Brasileira de Fisica, Sao Paulo). 1986. vp. (In Portuguese). (CONF-8604347—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW.

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

Separate abstracts were prepared for the papers in this meeting.

2486 **(INIS-BR—751) Moessbauer effect of /sup 197/Au, /sup 99/Ru, /sup 193/Ir, /sup 195/Pt, and /sup 151/Eu diluted in hydrogenated palladium.** Iannarella, L.V. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1977. 92p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703502/JAW.

The study of hidrogenation in transition metals by Moessbauer spectroscopy of /sup 197/Au, /sup 99/Ru, /sup 195/Pt, /sup 193/Ir and /sup 151/Eu diluted in palladium is presented. The measured parameters in the Moessbauer effect are sensitive to hydrogenation and allow to obtain information about phases of hydrogened systems, modifications of electronic structure and effects related to hydrogen mobility. The (Pd/sub 1-x/ Ag/sub x/)/sub 0.99/ Au/sub 0.01/ was also investigated by /sup 197/Au Moessbauer effect. The relantioship between α and β phase Debye-Waller factors by Moessbauer effect was estimated. Source and absorber Moessbauer experiments to verifying isomer shift variation in function of hydrogen concentration were done. A proposal for description of the isomer shift of transition (or rare) impurities in transition matrices from state density of each system is presented. The contribution of H/sup +/ ions bound to IS is discussed qualitatively. (M.C.K.).

2487 **(INIS-BR—754) Systematic and random erros in lattice parameter determinations.** Nascimento, E.M. (Bahia Univ., Salvador (Brazil)). 1980. 79p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703504/JAW.

A new method is proposed for evaluation of diffraction data used in precise determination of lattice parameters. The method is based on separation and systematic erros on the diffraction angles level, where the randon part of erros is independent on the 0 angle. The separation is enable by assumption that the systematic part of erros depends on the 0 angle linearly. In that situation the high precision in lattice parameters determination is related more to reducing the randon errors content that to the presence of unremoved systematic errors.

2488 **(INIS-BR—815) Contribution to knowledge of radiation damage in KCl crystals doped with Sr.** Sordi, G.-M.A.A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nov 1974. 176p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87703713/JAW.

The radiation damages in KCl crystals doped with Sr/sup ++/ using thermo-ionic technique (ITC) and optical absorption measurements were studied. The variation of the entropy for the dipole jump starting from results reported by several authors was calculated. The irradiation effects with three different exposures were analysed: irradiation with gamma rays; irradiation with fast

neutrons added to gamma irradiation; and irradiation with thermal neutrons together with fast neutrons and gamma rays.

2489 **(INIS-BR—817) Strong quadrupole interaction in electron paramagnetic resonance. Study of the indium hexacyanide (III) in KCl irradiated with electrons.** Vugman, N.V. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Aug 1973. 111p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703715/JAW.

The radiation effects in [Ir/sup III/ (CN)/sub 6/]/sup 3-/ diamagnetic complexe inserted in the KCl lattice and irradiated with electrons of 2MeV by electron spin resonance (ESR) are analysed. Formulas for g and A tensors in the ligand field approximation, are derivated to calculate non coupling electron density in the metal. The X polarization field of inner shells is positive, indicating a 6s function mixture in the non coupling electron molecular orbital. The observed hyperfine structure is assigned to 4 equivalent nitrogen and one non equivalent nitrogen. This hypothesis is verified by experience of isotope substitution with /sup 15/N. The s and p spin density in ligands are calculated and discussed in terms of molecular obitals. The effects of strong quadrupole interaction into the EPR spectra of [Ir/sup II/ (CN)/sub 5/]/sup 3-/ complex are analysed by MAGNSPEC computer program to diagonalize the Spin Hamiltonian of the system. Empiric rules for EPR espectrum interpretation with strong quadrupole interaction. A review of EPR technique and a review of main concepts of crystal-field and ligand field theories, are also presented. (M.C.K.).

2490 **(INIS-BR—839) Photoluminescence and excitation spectra of GaAs-Ga(Al)As strongly coupled double well superlattice.** Emmel, P.D.; Marques, G.E. (Sao Carlos Univ. (Brazil). Dept. de Fisica). 1985. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703735/JAW.

The electron and holes mini-bands are calculated as a function of the parallel momentum for a strongly coupled double well structure. Photoluminescence and excitation spectra for 45A GaAs wells separated by 12A Ga(Al)As barrier is analyzed.

2491 **(INIS-BR—840) Numerical difficulties to obtain 3-d critical exponents from platonic solids.** Alcaraz, F.C.; Herrmann, H.J. (Sao Carlos Univ. (Brazil). Dept. de Fisica). 1985. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703736/JAW.

The possibility to extract critical exponents of 3-d systems exploring the mass gap amplitudes of platonic solids is tested. For the Ising model the proposed method does not work for numerical reasons.

2492 **(INIS-mf—10579) 24. Science week. Pt.2.** (Super-Temp Corp., Santa Fe Springs, CA (USA)). 1984. vp. (CONF-8411294—Pt.2). NTIS (US Sales Only), PC A16/MF A01. Order Number DE87780099/JAW.

From 24. science week; Aleppo, Syria (3 Nov 1984).

Three separate abstracts from this conference were presented and selected for the Energy Data Base.

2493 **(INIS-mf—10975) Noble-gas ion bombardment on clean silicon surfaces, studied using ellipsometry and desorption.** Holtslag, A.H.M. (Technische Univ. Twente, Enschede (Netherlands)). 26 Jun 1986. 186p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE87703757/JAW.

This thesis describes a study concerning the influence of low-energy (0.5 - 2.5 keV) noble-gas ion bombardment (He/sup +/, Ne/sup +/, Ar/sup +/, kr/sup +/) on clean silicon surfaces (c-Si: (111), (110), (100)), carried out in an ultrahigh-vacuum (UHV) system. During ion bombardment spectroscopic ellipsometry has been used to characterize the different processes. The low-dose behaviour reflects the amorphism (a loss of long-range order) of the original c-Si surface layer. In order to explain the high-dose behaviour desorption experiments have been carried out, while information is obtained concerning the anneal behaviour of the damaged implanted surface layer. (Auth.). Includes Dutch summary; 143 refs.; 98 figs.; 65 tabs.

2494 **(INIS-mf—10981) Formation of negative ions on a metal surface.** Amersfoort, P.W. van. (Amsterdam Univ. (Netherlands)). 7 Jan 1987. 122p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703569/JAW.

In this thesis a fundamental study of the charge exchange process of positive ions on the converter surface is presented. Beams of hydrogen ad cesium ions are scattered from a thoroughly cleaned W(110) surface, under ultra-high vacuum conditions. The cesium coverage of the surface is a controlled parameter. Ch. 2 deals with the negative-ion formation probability for hydrogen atoms. The influence of coabsorption of hydrogen is studied in Ch. 3. These measurements are important for understanding the formation process in plasma sources, because the converter surface is expected to be strongly contaminated with hydrogen. The charge state of scattered cesium particles is investigated in Ch. 4. Knowledge of this parameter is essential for Ch. 5, in which a model study of adsorption of cesium on a metal surface in contact with a plasma is presented. Finally, the negative-ion formation process in a plasma environment is studied in Ch. 6. Measurements done on a hollow-cathode discharge equipped with a novel type of converter, a porous tungsten button, are discussed. Liquid cesium diffuses through this button towards the side in contact with the plasma. (Auth.). Includes Dutch summary

2495 **(INIS-mf—10990) Pulse radiolysis with (sub) nanosecond time resolution using a 3 MV electron accelerator.** Luthjens, L.H. (Technische Univ. Delft (Netherlands)). 9 Dec 1986. 147p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE87703760/JAW.

In this thesis the development of equipment for pulse radiolysis is described and the application of the technique to time-resolved measurements of the fluorescence emission of excited states formed after irradiation of some alkanes is dealt with. A review is given of the development of the pulsed 3MV Van de Graaf electron accelerator for the generation of subnanosecond electron beam pulses and of the development of the equipment for optical detection as accomplished by the author. The initial stage of a further development for shorter pulses and higher time resolution is briefly discussed. A collection of papers on the development of apparatus and a collection of papers dealing with the results obtained from measurements of the fluorescence of excited states, formed by the recombination of electrons and ions in irradiated alkanes such as cyclohexane and the decalines, are included. Includes Dutch summary

2496 **(INIS-SU—408) Surface and bulk magnetoplasma polaritons in the metal-semiconductor-dielectric structure. Preprint-no--310.** Beletskij, N.N.; Gasan, E.A.; Yakovenko, V.M. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1986. 48p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703578/JAW.

The dispersion properties of bulk and surface magnetoplasma polaritons in the three-layed metal-semiconductor-dielectric structure have been investigated. Resonance interaction of surface magnetoplasma polaritons propagating along two boundaries of the semiconductor layer has been predicted. It is shown that at the definite direction of propagation on the dispersion curves of the surface and bulk magnetoplasma polaritons there are sections with negative dispersion. Accounting of the losses in the semiconductor layer leads to the decomposition of the initial branches of dispersion dependences into the curves of two types, corresponding to direct and backward waves. Non-reciprocal propagation of the bulk magnetoplasma polaritons has been founs. 16 refs.; 24 figs.; 1 tab.

2497 **(IPNO-DRE—86-20) Measurements of the average equilibrium charge of fast heavy ions in a solid by H/sup +/ emission at the exit surface.** Della-Negra, S.; Le Beyec, Y.; Monart, B.; Standing, K.; Wien, K. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752727/JAW.

Measurement of the H/sup +/ secondary ion yield from the beam exit side of a solid target has been used as a sensitive probe of the charge state of an energetic heavy ion (1.16 MeV/u) at the instant that this projectile leaves the solid. Mean charges of /sup 84/

Kr ions in targets of Au, C or nitrocellulose were found to be 1.6 to 3 electronic charges (e) less than the values observed 70 ns later, after Auger decay, in qualitative agreement with the multiple-excitation model. However, no such difference was observed for Ar ions of the same velocity, suggesting that multiple excitation is important only for projectiles of higher Z.

2498 **(KURRI-TR—289) Proceedings of the specialist research meetings on semiconductors with research reactors.** Kawakubo, Tetsuya; Kimura, Itsuro (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 1987. 62p. (In Japanese). (CONF-8607343—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750039/JAW.

From Specialist research meetings on semiconductors with research reactors; Kumatori, Japan (21 Jul 1986).

The meeting was proceeded divided five sessions, (I) structure analysis of semiconductors with neutrons, (II) structure analysis with positrons, (III) neutron transmutation doping and radiation damage, (IV) discussion on the way of research on semiconductors in the Institute.

2499 **(LA-UR—87-2869) Theory and simulations of Zone II microstructures in thin films.** Srolovitz, D.J.; Mazor, A.; Bukiet, B.G.; Hagan, P.S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-871125—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014752/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

The nature of the microstructure of vapor-deposited films is known to depend sensitively on the substrate temperature during deposition. At intermediate temperatures (T ~ .45 Tm where Tm is the melting point of the film) the film is made up of columnar-grains separated by metallurgical grain boundaries. Both an analytical and numerical analysis is presented in which the space-time evolution of the columnar microstructure (Zone II) is studied.

2500 **(SAND—87-1100C) Selective laser-induced photochemical dry etching of semiconductors controlled by ion-bombardment-induced damage.** Ashby, C.I.H.; Myers, D.R.; Vook, F.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871027—36). NTIS, PC A02. Order Number DE88001356/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The etch rate of a solid-excitation-based photochemical etching process for semiconductor materials is determined by the balance between recombination of photogenerated carriers and carrier participation in the surface etching reaction. Ion-implantation-induced damage of the semiconductor can shift the balance between recombination and reaction, permitting selective etching of undamaged regions of a semiconductor surface relative to ion-implanted, damaged regions. Spatially selective photochemical dry etching of n-GaAs has been achieved by this approach. 10 refs.

2501 **(UCRL—15939) Surface modification by ion mixing: Final technical report, 1 November 1985-31 December 1986.** (Lawrence Livermore National Lab., CA (USA)). 20 Jul 1987. Contract W-7405-ENG-48. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000786/JAW.

The goal of this project was to determine if a thin Mo film deposited on a U substrate can be intermixed by irradiation with energetic Xe ions. It is known that alloying U with Mo significantly enhances the corrosion resistance of U. The idea is to achieve this beneficial effect superficially, so as to avoid alloy formation in the bulk phase, and to achieve the surface modification in a manner that would be more efficient than ion implantation.

2502 **(UCRL—97367) Ti foil light in the ATA [Advanced Test Accelerator] beam.** Slaughter, D.R.; Chong, Y.P.; Goosman, D.R.; Rule, D.W.; Fiorito, R.B. (Lawrence Livermore National Lab., CA (USA); Naval Surface Weapons Center, Silver Spring, MD (USA)). Sep 1987. Contract W-7405-ENG-48. 6p. (CONF-8709146—4). NTIS, PC A02. Order Number DE88000227/JAW.

From SDIO/DARPA services annual propagation review; Monterey, CA, USA (29 Sep 1987).

An experiment is in progress to characterize the visible light produced when a Ti foil is immersed in the ATA 2 kA, 43 MeV beam. Results obtained to date indicate that the optical condition of the foil surface is a critical determinant of these characteristics, with a very narrow angular distribution obtained when a highly polished and flat foil is used. These data are consistent with the present hypothesis that the light is produced by transition radiation. Incomplete experiments to determine the foil angle dependence of the detected light and its polarization are summarized and remaining experiments are described.

2503 **Explosive vaporization of small droplets by a high-energy laser beam.** Chitanvis, S.M. (Theoretical Division, Los Alamos National Laboratory, MS-K723, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **62**: No. 11, 4387-4393(1 Dec 1987).

We have constructed a model of the explosive vaporization of small droplets caused by the absorption of energy from a high-energy laser beam. The model consists of polarizable fluid streaming from the exploded droplet and interacting with laser radiation. A novel criterion for the explosive vaporization in the droplet is introduced, in which the absorbed energy density has to be greater than the restrictive pressure due to surface tension. Self-similarity is invoked to reduce the spherically symmetric problem involving hydrodynamics and Maxwell's equations to simple quadrature. We have compared our model with experiments. An analytic solution has been obtained in a limiting case.

2504 **Diffusive and convective vaporization of irradiated droplets.** Armstrong, R.L.; Zardecki, A. (Physics Department, New Mexico State University, Las Cruces, New Mexico 88003). *Journal of Applied Physics;* **62**: No. 11, 4571-4578(1 Dec 1987).

A generalized vaporization model is developed which describes the evaporation of a spherical liquid droplet irradiated by a high-intensity, pulsed laser beam. Diffusive and convective transport processes are included in the hydrodynamic description of a two-component system composed of droplet vapor and ambient gas. Numerical solutions to the two-component hydrodynamic equations are obtained which illustrate the ability of the model to describe both isobaric vaporization, and convective vaporization with the production of shock waves.

6561 Superconductivity

REFER ALSO TO CITATION(S) 1180, 1211, 1231, 1237, 1240, 1241, 1242, 1286

2505 **(LA-UR—87-2617) Resistivity of EuBa$_2$(Cu/sub 1-y/Zn/sub y/)$_3$O/sub x/ as a function of temperature, magnetic field, pressure and Zn concentration.** Borges, H.A.; Wells, G.L.; Cheong, S.W.; Kwok, R.S.; Thompson, J.D.; Fisk, Z.; Smith, J.L.; Oseroff, S.B. (Los Alamos National Lab., NM (USA); San Diego State Univ., CA (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-870881—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014740/JAW.

From 18. conference on superconductivity in highly correlated fermion systems; Sendai, Japan (31 Aug 1987).

We report electrical resistance and magnetoresistance measurements on EuBa$_2$(Cu/sub 1-y/Zn/sub y/)$_3$O/sub x/ under pressure to 17 kbar. With Zn substitution, T/sub c/ is depressed rapidly (~19 K/at.% Zn) and there are qualitative changes in the temperature and field response of the resistance. Pressure drives the Zn-substituted samples toward undoped EuBa$_2$Cu$_3$O/sub x/ behavior. Analysis of the temperature dependent resistance for y = 0.05 and P = O, together with Hall effect and thermopower data, suggests that the suppression of superconductivity may arise from weak three-dimensional localization promoted by Coulomb interactions.

2506 **(LBL—23121) Effect of dissipation on macroscopic quantum tunneling.** Cleland, A.N.; Martinis, J.M.; Clarke, J. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 4p. (CONF-870873—16). NTIS, PC A02. Order Number DE87014690/JAW.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

We report measurements of the escape rate from the zero-voltage state of a current-biased Josephson junction shunted by a normal-metal resistor. The critical current, capacitance, and resistance of the junction were measured in the classical regime. The escape rate was measured in both the high-temperature regime, where thermal activation dominates, and in the low-temperature regime, where macroscopic quantum tunneling dominates. The measured escape rates are in good agreement with the predicted escape rates with respect to both the effect of dissipation and the existence of quantum corrections to thermal activation.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 1174, 1355, 1468, 1488, 1669, 2209, 2209, 2306, 2307, 2323, 2327, 2328, 2329, 2451, 2534

2507 **(CBPF-NF—038/86) D-Dimensional ideal gas in parastatistics: thermodynamic properties.** Sousa Vieira, M.C. de; Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703672/JAW.

A parastatistics ideal gas with energy spectrum ϵ is proportional to chemical bondkchemical bond -> sup (α) (α>0) or even more general in a d-dimensional box with volume V (periodic boundary conditions), the number N of the gas particles being well determined (real particles) or not (quasi particles), is considered. The main thermodynamic quantities (chemical potential, internal energy, specific heat C, equation of state, latent heat, average numbers of particles) for arbitrary d,α, T (temperature) and p (maximal number of particles per state allowed in the parastatistics), are calculated. The main asymptotic regimes are worked out explicitly. In particular, the Bose-Einstein condensation for fixed density, N/V appears as a non uniform convergence in the p-> ∞ limit, in complete analogy with the standard critical phenomena which appear in interacting systems in the N -> ∞ limit. The system behaves essentially like a Fermi-Dirac one for all finite values of p, and reveals a Bose-Einstein behavior only in the p -> ∞ limit. For instance, at low temperatures C proportional to T if p< ∞ and C proportional to T/sup d/α/ if p -> ∞. Finally the Sommerfeld integral and its expansion are generalized to an arbitrary finite p.

2508 **(CEA-CONF—8893) Exact 1+1 dimensional solutions of discrete Boltzmann models with three and four different densities.** Cornille, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Dec 1986. 12p. (CONF-861296—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752929/JAW.

From 264. RCP meeting on inverse problems; Montpellier, France (1 Dec 1986).

We review recent determinations of exact 1+1 dimensional solutions for discrete 2-4-6 velocity models with two, three and four different densities. These solutions are sums of two rational solutions with two independent exponential variables and nonlinear coupling relations. They correspond either to nonplanar shockwaves or to periodic solutions.

2509 **(CEA-CONF—8948) Second order scheme for reacting flows. Application to detonation.** Bourgeade, A. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 13p. (CONF-8702100—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752754/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

The approximate solution of the generalized Riemann's problem for reacting fluids allows the extension of Van leer's scheme to reacting flows. The presentation will describe this new scheme. The given examples will show very good improvements in comparison with the classical methods applied for reacting flows. The main reasons are the absence of pseudoviscosity in this new scheme, and the fact that the reaction rate is used in the generalized Riemann's problem's solution.

2510 **(CEA-CONF—8949) Generalized Riemanns problem.** Bourgeade, A. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 13p. (CONF-8702100—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752755/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

We study the flow resulting from a discontinuity line between two fluids. Those two fluids are, at the initial time, in two different and non necessarily constant states. The first two terms of an asymptotic expansion for this flow are derived as solutions of ordinary differential equations. Those terms are obtained not only in planar, cylindrical or spherical symmetry, but also for inert or reacting fluids. The expansion is introduced in a second order Godunov type scheme that gives very nice results.

2511 **(CEA-CONF—8951) Smoothed particle code 2D compressible multifluid flows.** Bailly, F.; Ovadia, J. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 16p. (CONF-8702100—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752757/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

The algorithm is based on an extension of Monaghan's smoothed particle method. The code is able to compute multifluid unsteady flows involving strong shocks and great deformations. Each particle moves in the physical space with its mass, momentum, energy and material nature. The particles are Lagrangian and keep constant mass, but they ex-change momentum and energy, by one to one interaction. The interaction depends on the positions of the particles, the amount of their quantities and the cut off. So the algorithm needn't any mesh. In the present paper, first we describe the scheme, we present a computed solution of a physical problem to show some possibilities of the method.

2512 **(CEA-CONF—8952) Personal view on homogenization.** Tartar, L. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 12p. (CONF-8702100—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752758/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

The evolution of some ideas is first described. Under the name homogenization are collected all the mathematical results who help understanding the relations between the microstructure of a material and its macroscopic properties. Homogenization results are given through a critically detailed bibliography. The mathematical models given are systems of partial differential equations, supposed to describe some properties at a scale ϵ and we want to understand what will happen to the solutions if ϵ tends to 0.

2513 **(CEA-CONF—8953) T.V.D. Schemes for Lagrangian hydrodynamics.** Desgraz, J.C. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 14p. (CONF-8702100—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752759/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

We present here two extensions of T.V.D schemes for solving the equations of hydrodynamic in one space dimension. The first is the preprocessing method. The second is the limited antidiffusion method.

2514 **(CEA-CONF—8954) Fast high precision rezoning algorithm.** Meltz, B. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 12p. (CONF-8702100—7). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752760/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

In an adaptive mesh algorithm, as well as to maintain a proper mesh in a standard quadrilateral hydro code, it is necessary to have a rezoning algorithm. It should be as precise as possible, in order to introduce the less diffusion possible, and fast, to be performed as often as needed. The one we present, which makes use of the lagrangian alternate directions method, but not flux or operator splitting, reduces drastically the number of geometrical calculations (intersections of lines and areas of polygons), and transfers the rezoning work itself to a 1D algorithm, which can be made as fast and precise as needed. We present the method, with special emphasis on the treatment of node centered velocities, and a variety of examples: pure advection, static rezoning, hydro-calculations with automatic rezoning.

2515 **(CEA-CONF—8955) GAIA: A 2-D Curvilinear moving grid hydrodynamic code.** Jourdren, H. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 14p. (CONF-8702100—8). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752761/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

The GAIA computer code is developed for time dependent, compressible, multimaterial fluid flow problems, to overcome some drawbacks of traditional 2-D Lagrangian codes. The initial goals of robustness, entropy accuracies, efficiency in presence of large interfacial slip, have already been achieved. The general GODUNOV approach is applied to an arbitrary time varying control-volume formulation. We review in this paper the Riemann solver, the GODUNOV cartesian and curvilinear moving grid schemes and an efficient grid generation algorithm. We finally outline a possible second order accuracy extension.

2516 **(IFUSP-P—604) Homogeneous space-time of Goedel type in higher-derivate gravity.** Accioly, A.J.; Goncalves, A.T. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Oct 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703690/JAW.

A general theorem concerning any Goedel-type solution of higher-derivative gravity field equations, which may be produced by any reasonable physical source with a constant energy-momentum tensor, is analysed. The resulting class of metrics dependes on two parameters, one of which is related to the vorticity. A general class of solutions of Goedel-type space-time-homogeneous universes in the context of the higher-derivative theory is exhibited. This is the most general higher-derivative solution of such type of metric and includes all known solutions of Einstei's equations related to these geometries as a special case. A number of completely causal rotating models is also obtained. Some of them present the interesting feature of having no analogous in the framework of general relativity.

2517 **(IFUSP-P—608) Finite p/sub t/ contribution to relativistic Coulomb excitation: A possible explanation for the clean fission puzzle.** Galetti, D.; Kodama, T.; Nemes, M.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Oct 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703691/JAW.

The quantum relativistic Coulomb excitation process including reccil effects is studied in the plane wave Born approximation. Quantum and relativistic recoil effects allow for relatively large transverse momentum transfers, usually neglected. This specific feature is shown to modify the angular distribution of Coulomb induced fission fragmentation in an essential manner. In contrast with usual treatments it is found that these results compare favourably with recent data. (Authors).

2518 (INIS-SU—424, pp 37-47) **Open quantum system of two coupled harmonic oscillators.** Sandulesku, A.; Scutaru, H.; Scheild, W. 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780011/JAW. (JINR-N—18-86).

In JINR rapid communications. Collection.

On the basis of the Lindblad theory for open quantum systems are derived master equations for a system consisting of two harmonic oscillators. The time-dependence of expectation values, Wigner-function and Weyl operator are obtained and discussed. The chosen system can be applied for the description of the charge and mass asymmetry degrees of freedom in deep inelastic collisions in nuclear physics. 7 refs.

2519 **(LA-UR—87-2942) Chaos: Chto Delat?.** Campbell, D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 23p. (CONF-870159—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000513/JAW.

From International conference on physics of chaos and systems far from equilibrium; Monterey, CA, USA (11 Jan 1987).

Provided is a brief overview of the current status of the field of deterministic "chaos", stressing its interrelations and applications to other fields and suggesting a number of important open problems for future study.

2520 **(N—87-25546) Numerical solution of the unsteady Navier-Stokes equation. Semiannual report.** Osher, S.J.; Engquist, B. (California Univ., Los Angeles (USA)). 1985. 61p. (NASA-CR—181173; NAS—1.26:181173). NTIS, PC A04/MF A01.

The construction and the analysis of nonoscillatory shock capturing methods for the approximation of hyperbolic conservation laws are discussed. These schemes share many desirable properties with total variation diminishing schemes, but TVD schemes have at most first-order accuracy, in the sense of truncation error, at extrema of the solution. In this paper a uniformly second-order approximation is constructed, which is nonoscillatory in the sense that the number of extrema of the discrete solution is not increasing in time. This is achieved via a nonoscillatory piecewise linear reconstruction of the solution from its cell averages, time evolution through an approximate solution of the resulting initial value problem, and averaging of this approximate solution over each cell.

2521 (N—87-26531, pp vp) **Study of the XY model by the Monte Carlo method.** Suranyi, P.; Harten, P. Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

The massively parallel processor is used to perform Monte Carlo simulations for the two dimensional XY model on lattices of sizes up to 128 x 128. A parallel random number generator was constructed, finite size effects were studied, and run times were compared with those on a CRAY X-MP supercomputer.

2522 (N—87-26531, pp vp) **Fast MPP algorithm for Ising spin exchange simulations.** Sullivan, F.; Mountain, R.D. Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

A very efficient massively parallel processor (MPP) algorithm is described for performing one important class of Ising spin simulations. Results and physical significance of MPP calculations using the method described is discussed elsewhere. A few comments, however, are made on the problem under study and results so far are reported. Ted Einstein provided guidance in interpreting the initial results and in suggesting calculations to perform.

2523 (N—87-26531, pp vp) **Simulation of charged particle transport on the MPP.** Earl, J.A. Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

Computations of cosmic ray transport based upon finite difference methods are afflicted by instabilities, inaccuracies, and artifacts. To avoid these problems, a Monte Carlo formulation was developed which is closely related not only to the finite difference formulation, but also to the underlying physics of transport phenomena. Implementations of this approach are currently running on the Massively Parallel Processor at Goddard, whose enormous computing power overwhelms the poor statistical accuracy that

usually limits the use of stochastic methods. In a Monte Carlo simulation of rectilinear transport, the coherent and diffusive effects that appeared are in good quantitative agreement with both finite difference and analytical calculations.

2524 **(RAL—86-097) Ambiguity in determining the effective action for string-corrected Einstein gravity.** Hochberg, D.; Shimada, T. (Rutherford Appleton Lab., Chilton (UK)). Nov 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752952/JAW.

The authors attempt to clarify some issues dealing with the determination of some of the coefficients appearing in the low-energy gravitational effective action for closed strings. In particular, the coefficients of the $Rsub(\mu\nu)^2$ and R^2 terms of the quadratic curvature corrections to the Einstein-Hilbert action are shown not to be determined by matching the on-shell S-matrices of the effective theory with that of the string theories. The mechanism responsible for the ambiguity of these coefficients is revealed as a cancellation among the contact, exchange and point-insertion terms contributing to the tree S-matrix of the effective local theory. Although ghost poles will appear in the graviton propagator for general quadratic curvature corrections, the effective theory remains unitary. The manifest absence of ghosts is achieved by choosing the Gauss-Bonnet combination of quadratic curvature terms, but the string does not single out this combination over any other.

2525 **(UCID—21062) 2, Pulse-mode expansions and refractive indices in plane-wave propagation.** Shore, B.W.; Sacks, R.; Karr, T.; Morris, J.; Paisner, J.A. (Lawrence Livermore National Lab., CA (USA)). 20 Jun 1987. Contract W-7405-ENG-48. 44p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88001328/JAW.

This memo presents basic background theory for treating simultaneous propagation of electromagnetic pulses of various colors, directed along a common ray, through a molecular vapor. The memo discusses some techniques for expanding the positive frequency part of the transverse electric field into pulse modes, characterized by carrier frequencies within a modulated envelope. We discuss, in the approximation of plane waves with slowly varying envelopes, a set of uncoupled envelope equations in which a polarization mode-envelope acts as a source for an electric-field envelope. These equations, when taken with a prescription for the polarization field, are the basic equations of plane-wave pulse propagation through a molecular medium. We discuss two ways of treating dispersive media, one based upon expansions in the frequency domain and the other based in the time domain. In both cases we find envelope equations that involve group velocities. This memo represents a portion of a more extensive treatment of propagation to be presented separately. Many of the equations presented here have been described in various books and articles. They are collected and described here as a summary and review of contemporary theory.

2526 **Destabilization of islands in noisy Hamiltonian systems.** Gyoergyi, G.; Tishby, N. (Department of Physics, Stevens Institute of Technology, Hoboken, New Jersey 07030). *Physical Review [Section] A: General Physics;* **36**: No. 10, 4957-4967(15 Nov 1987).

The effect of noise on the period-doubling scenario in Hamiltonian systems is considered. The escape time from islands is found to exhibit asymptotically universal scaling. With use of renormalization theory, it is shown that there is a universal noise distribution and a scale factor associated with it, responsible for self-similarity with noise. The fast transport within chaotic regions enhances diffusion, which obeys an anomalous power law.

2527 **Class of classically chaotic time-periodic Hamiltonians which lead to separable evolution operators.** Visscher, W.M. (Theoretical Division (Mail Stop) B262, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **36**: No. 10, 5031-5045(15 Nov 1987).

If V(r) is homogeneous in the position coordinates, then the Schroedinger equation with $H(t) = T+\alpha(t)V(r)$ is separable in time if $\alpha(t)$ is properly chosen. This fact makes the time evolution of such systems much easier to compute than it would otherwise be. Examples of such systems are the hydrogen atom with time-varying nuclear charge, the harmonic oscillator with a changing spring constant, and the infinite square well with moving walls. If $\alpha(t)$ is made periodic by concatenating "properly chosen" segments, then a unitary operator U can be defined which evolves the system through one period. If the wave function is expressed as an N-term truncated expansion of eigenfunctions of H(t), then U is an N x N matrix which can be computed straightforwardly. The properties of U are studied by examining the statistical properties of its eigenvectors and eigenvalues, whose phases are the quasienergies. Numerical examples are given for the Fermi-Ulam cosmic accelerator (FUCA), which is a particle in a one-dimensional box with a moving wall, with various values for relevant parameters, which can lead to Poisson, Gaussian orthogonal ensemble, Gaussian unitary ensemble, or other quasienergy statistics, corresponding to inte- grable, chaotic, and non-time-reversible chaotic situations. Poincare sections for the classical FUCA are also displayed. They show regimes of regular and of chaotic motion, whose correspondence with the statistics of U is sought with limited success.

2528 **Microscopic aspects implied by the Second Law.** Kondepudi, D.K. (Univ. of Texas, Austin). *Foundations of Physics;* **17**: No. 7, 713-722(Jul 1987). Contract AS05-81ER10947.

It is conventional to try to arrive at the Boltzmann principle and the Second Law starting with the laws of dynamics at the microscopic level. In this article the opposite view is presented: Starting with the Second Law, microscopic properties are derived. A classical result of Wien is developed into a general theorem, and the possibility of deriving the Boltzmann principle as a consequence of Carnot's theorem is discussed.

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 954, 958

7001 Plasma Research

REFER ALSO TO CITATION(S) 2070, 2091, 2684

2529 **(ANU/TPP—86/01) On the normal mode equations of a diffuse linear pinch.** Sy, W.N.-C. (Australian National Univ., Canberra. Research School of Physical Sciences). Jan 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700099/JAW.

The system of normal mode equations for a low-β diffuse linear pinch has been extended to include ion cyclotron ranges of frequencies and multiple ion species. It is shown that the system retains the same formal structure as that for ideal MHD, which can be formulated as a system of two coupled first order differential equations.

2530 **(ANU/TPP—86/02) Free-boundary equilibrium problem for helically symmetric plasmas.** Gardner, H.J.; Dewar, R.L.; Sy, W.N.-C. (Australian National Univ., Canberra. Research School of Physical Sciences). May 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700101/JAW.

An iterative technique for solving the ideal MHD equilibrium equations for a helically symmetric plasma with a free boundary is described. The method involves an application of Green's theorem and has been formulated for the geometry of a heliac. It is used to determine a stability diagram for the SHEILA heliac as a function of the plasma pressure and the current in one of the external coils.

2531 **(CEA-CONF—8864) Density fluctuations and channel mixing effects in the absorption of light by dense plasmas.** Grimaldi, F.; Grimaldi-Lecourt, A.; Dharma-Wardana, M.W.C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Oct 1986. 30p. (CONF-8610121—2). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752909/JAW.

From 3. international conference on the radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1986).

The independent particle picture of light absorption is well known to be quite inadequate for a proper description of the absorption cross section of light by atoms due to the screening of the incident electric field arising from the relaxation of the system via density fluctuations, channel mixing, exchange and correlation effects etc. We exploit the simplicity and the proven success of time dependent local density approximation (TDLDA) and density functional theory to introduce these many body effects into calculations of light absorption by plasmas. Calculations for an iron plasma at normal density and at a temperature of 100 eV are presented together with details of computational aspects necessary for the implementation of the method.

2532 **(CEA-CONF—8957) Physico-numerical treatment of large angle scattering during alpha particle slowing down.** Morreeuw, J.P. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 12p. (CONF-8702100—10). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752763/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

The slowing down of a suprathermal test particle (alpha particle) by a continuous background of weakly coupled plasma is described. In order to compute the collision terms, the large energy exchange interactions are assumed to be well described by the binary (nuclear and Coulomb) shock theory, with no use of any screening potential. The aim is to get a well posed approximation that gives an accurate description of large energy exchange interactions. The discretization by one-sided difference scheme is stable treatment. The implementation of this treatment is very easy in any deterministic standard moment method.

2533 **(CEA-CONF—8959) Molecular dynamics simulation of the two-dimensional ion-electron plasma in the strong coupling regime.** Clerouin, J.; Hansen, J.P. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 12p. (CONF-8702100—11). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752764/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

We have carried out Molecular Dynamics simulations on a two-dimensional plasma made up of ions of charge +e and size d held fixed (infinite mass) on the sites of a hexagonal lattice, and of classical electrons of charge -e moving in the periodic field of the ions. This fixed-ion model maps the dielectric-plasma transition of the two-dimensional Coulomb gas onto a delocalization transition of the electrons. The main diagnostics in our simulations are the electron self-diffusion constant D and the d.c conductivity σ, which vanish below a density dependent threshold temperature T/ sub 1/. The simulations amount to integrating the coupled classical equations of motion on the CRAY-1 over times spanning up to 10/ sup 3/ plasma oscillations, and allow a detailed study of ion-electron recombinations and the single-particle and collective motions of the electrons.

2534 **(CEA-CONF—8961) Comparison of two models of Rayleigh-Taylor induced turbulent mixing.** Besnard, D.; Haas, J.F.; Bonnet, M.; Froger, A.; Gauthier, S.; Sitt, B.; Harlow, F.H. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1987. 12p. (CONF-8702100—13). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752766/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

Turbulent mixing of two species occurs in a variety of natural and technological phenomena such as diffusion of pollutants in the atmosphere or oceans, combustion, and inertial confinement fusion (ICF). We compare here two turbulence models in the special case of Rayleigh-Taylor instability induced turbulent mixing in a variety of experiments for one-dimensional mean-flows.

2535 **(CLM-R—269) Application of some novel methods of time series analysis to tokamak data.** Arter, W.; Edwards, D.N. (UKAEA Culham Lab., Abingdon). Aug 1986. 48p. H.M. Stationery Office, London, price Pound5.00.

A time series may be regarded as a structure (manifold) in a multi-dimensional space if delay co-ordinates are used. To such manifolds may be assigned a dimension (not necessarily an integer), a measure of the complexity of the signal, and Lyapunov exponents, which measure the rate at which successive oscillations become decorrelated. In addition a special coordinate system, which can help further unravel the complexity of the time series, may be constructed. Successful applications of the first two measures to data from the DITE tokamak are described with an emphasis on issues such as signal-to-noise ratio and minimum sample size. The third technique when applied to DITE data, appears to be useful only as a method for quantifying and removing noise.

2536 **(DOE/ER/52133—2) ICRF launcher studies: Progress report.** Scharer, J.E. (Wisconsin Univ., Madison (USA). Dept. of Electrical and Computer Engineering). Sep 1987. Contract FG02-86ER52133. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001710/JAW.

The research we have accomplished during the past year includes the topics of ICRF fast wave coupling to L- and H-mode edge profiles, measurements of simulated plasma loads on an 85 MHz launcher, coupling of ion Bernstein waves and a simulation of the folded waveguide launcher. We have also begun to examine coupling between launched fast waves and ion Bernstein waves driven by density gradients near the plasma edge and the effects of known edge turbulence and ponderomotive forces on the direct launching of ion Bernstein waves. We find that a TE_{10} ICRF fast mode waveguide launcher has only a moderate increase in its reflection coefficient when coupling into a model H-mode plasma density profile. We find that linear coupling from fast modes to ion Bernstein modes can only occur with large density gradient scale lengths near the plasma edge. The current power level of ion Bernstein wave heating experiments is found to yield ponderomotive force effects which can substantially modify plasma edge density profiles. 7 refs.

2537 **(DOE/ER/53176—4) Theoretical plasma physics: Progress report, January 1, 1987-December 31, 1987.** Boozer, A.H.; Vahala, G.; Tracy, E.R. (College of William and Mary, Williamsburg, VA (USA)). Sep 1987. Contract FG05-84ER53176. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001475/JAW.

During the past year, research has been carried out on current drive in tokamaks and in spheromaks, fast integration techniques for magnetic field lines, alpha particle diagnostics that use CO_2 laser scattering, and plasma turbulence. This paper discusses this research.

2538 **(DOE/ER/53212—113) Reversed field pinch plasmas with various boundary conditions.** Almagri, A.F.; Assadi, S.; Dexter, R.N.; Ho, Y.L.; Proger, S.C.; Sarff, J.S.; Skinner, D.A.; Sprott, J.C. (Wisconsin Univ., Madison (USA). Plasma Physics Research). Sep 1987. Contract FG02-85ER53212. 24p. (CONF-870908—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000832/JAW.

From Course and workshop on physics of mirrors, reversed field pinches and compact tori; Varenna, Italy (1 Sep 1987).

RFP behavior with boundary conditions which deviate from the perfectly conducting circular shell are investigated theoretically and experimentally. Interchange (Mercier) stability and the resulting beta limits are evaluated for various noncircular shapes. Growth rates are calculated for various current-driven MHD instabilities for both resistive and distant walls. A sustained noncircular RFP experiment is operated to investigate magnetic fluctuations in regions of good and bad curvature. Behavior of a nonsustained RFP is investigated, in which the plasma is situated far from the conducting shell in a poloidal divertor configuration.

2539 **(DOE/ER/53216—T1) Tokamak ripple transport at arbitrary collision frequency.** Hitchon, W.N.G.; Beidler, C.D.; Shohet, J.L. (Wisconsin Univ., Madison (USA). Torsatron/Stellarator Lab.). Sep 1987. Contract FG02-86ER53216;FG02-85ER53201. 21p. (TSL—87-3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000687/JAW.

The bounce-averaged Fokker-Planck equation for the distribution function of ripple-trapped particles in a Tokamak has been solved, for arbitrary collision frequencies, in the 'Tokamak' limit in which ripple wells are localized close to the mid-plane. The equation includes the main terms contributing to collisionless (de)trapping. The solution employs power series expansions for the distribution function in the pitch-angle variable k^2 and the poloidal angle, θ; the series in k^2 and θ both terminate. The boundary conditions applied at the trapping-detrapping boundary, that f and $(\partial f/\partial k^2)$ be continuous, become requirements that in the collisionless limit the derivative with respect to k^2 reflects the scale length set by the motion in toroidally blocked orbits. The resulting series solutions reduce to the usual expressions in the high collision frequency limit, but are considerably lower than results of previous calculations (which neglect the collisionless detrapping effects), in the low collision frequency limit. Comparison with Monte-Carlo calculations for INTOR parameters shows that the analytic results lie somewhat below the numerical results, in all cases. Since banana-drift diffusion is also present in the Monte-Carlo calculation, this is a partial confirmation of the validity of our theory. 15 refs.

2540 **(DOE/ER/53237—1) Determination of atomic data pertinent to the Magnetic Fusion Program: Technical progress report, 15 May 1986-30 September 1987.** Wiese, W.L. (National Bureau of Standards, Washington, DC (USA)). 1987. Contract AI05-86ER53237. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000389/JAW.

Dielectronic recombination and excitation rates, electron-impact excitation and ionization cross sections, and wavelengths and energy levels of prominent spectral lines are experimentally and theoretically determined. Wavelengths for both electric and magnetic dipole transitions and atomic energy level data are also critically evaluated, compiled, and tabulated. Theoretical methods use both relativistic and nonrelativistic formulations. The work concentrated on ions of materials commonly used in current fusion devices, such as titanium, iron, and nickel, as well as heavier elements expected to be introduced into next-generation fusion devices for diagnostic purposes, such as krypton and xenon. The range of ions is extended to include very highly charged species in anticipation of needs in very high-temperature fusion devices such as TFTR and its successors. Work described also represents collaboration with major fusion laboratories such as Oak Ridge National Laboratory, Princeton Plasma Physics Laboratory, and GA Technologies.

2541 **(GA-A—18945) Leak detection on the DIII-D tokamak using helium entrainment techniques.** Brooks, N.H.; Baxi, C.; Anderson, P. (GA Technologies, Inc., San Diego, CA (USA)). Sep 1987. Contract AC03-84ER51044. 23p. (CONF-871125—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000388/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

The entrainment of helium in a viscous gas flow was utilized first to compartmentalize, and then to pinpoint a leak across the inner skin of the double-walled DIII-D vacuum vessel. Inaccessible from the outside, the leak connected the cooling channels in the wall interspace with the primary vacuum chamber. By entraining helium in the pressurized flow from the single-pass DIII-D gas circulation system, it was possible to expose well-defined portions of the wall to helium without disassembly of the poorly accessible cooling channel manifolds. Varying the point on the gas inlet manifold at which helium was injected permitted the localization of the leak to a single 30° toroidal sector of the vessel. The exact location of the leak was found from inside the vessel by spraying helium on suspect regions of the armor-clad skin, while sweeping the contents of the small-bore cooling channels to the foreline of a Varian Contraflow/T leak detector with a 0.1 Pa-m^3/s flow of nitrogen. Model calculations of the cooling tube geometry were used to predict the response time to entrained helium of the actual leak detection setup.

2542 **(IFUSP-P—599) Toroidal helical fields.** Kucinski, M.Y.; Caldas, I.L. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Aug 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703688/JAW.

Using the conventional toroidal coordinate system Laplace's equation for the magnetic scalar potential due to toroidal helical currents is solved. The potential is written as a sum of an infinite series of functions. Each partial sum represents the potential within some accuracy. The effect of the winding law is analysed in the case of small curvature.

2543 **(INIS-BR—841) Plasma heating by radio frequency in the LISA linear machine.** Cunha Raposo, C. da. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). May 1985. 158p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87703737/JAW.

The characteristics of an experimental apparatus to produce helium plasma by radio frequency and to study its behavior when confined by a magnetic field with mirrors is shown. The plasma was produced by a microwave source of 2.45 GHz and 800 Watts, operating in steady and pulsed state. The plasma parameters were studied as a function of an external magnetic field, for large and small resonance regions. The axial and radial magnetic fields were mapped for each region in order to verify the spatial distribution, particle orbits, and energy confinement time according to the energy balance equation. As a consequence of the influence of the radio frequency (RF) voltage in the plasma the Bohm theory of plasma prob was modified. The diagnostic was done with plane movable electrostatic probe, Hall probe, magnetic probe, diamagnetic coil and spectrography.

2544 **(INIS-BR—842) Propagation of quasi-static wave and resonance cone in magnetized plasma.** Serbeto, A.P.B. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). Aug 1980. 46p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703738/JAW.

The potential created by an oscillating punctual source in a magnetized homogeneous cold plasma, using quasistatic approximation is studied. The resonance cone structure in this plasma is theoretically obtained and it is verified that the conic field structure remains finite for an inhomogeneous cold plasma. The temperature effect in the resonance cone structure in layers where w->Ω/sub e/,w->w/sub PC/ and w->w/sub nh/ for magnetized homogeneous electron plasma is studied. An approximated expression for dispersion relations is obtained, so that an analytical solution for the potential in these layers can be calculated. The theorem of energy conservation for quasistatic waves is developed. (M.C.K.).

2545 **(INIS-BR—843) Laser-produced plasma in a niobium solid: study of its properties.** Oliveira Campos, D. de. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). Mar 1986. 78p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703739/JAW.

A system for plasma production by the incidence of a laser beam on a solid material surface in high vacuum was mounted. The plasma produced by the incidence of a ruby laser pulse (130MW, 50ns) on a niobium crystal surface, with a 35/sup 0/ inclination relative to the normal. The identification of spectral lines and the determination of the expanding plasma temperature were done using photographic film and an optic multichannel analyser coupled to a spectrometer. In order to determine the velocity of the plasma expansion, the time evolution of one spectral line was studied. The luminous events were registered by an image converter camera which records ultra short time-interval events. The shape and surface area of the holes created on the crystal surface were observed by electron microscopy. (M.C.K.).

2546 **(INIS-mf—4754-No.35) International bulletin on atomic and molecular data for fusion. No. 35.** Smith, J.J. (ed.). (International Atomic Energy Agency, Vienna (Austria). Atomic and Molecular Data Unit). May 1987. 99p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703551/JAW.

The bulletin provides information on atomic and molecular data for fusion research. In Part I the indexed papers are listed separately for structure and spectra, atomic and molecular collisions, and surface effects. Part II contains all the bibliographic data for both indexed and non-indexed references (536 references). An author index is included.

2547 **(INPE—3868) Electron Bernstein wave current drive in the start-up phase of a tokamak discharge.** Montes, A.; Ludwig, G.O. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Apr 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703582/JAW.

Current drive by electron Bernstein waves in the start-up phase of tokamak discharges is studied. A general analytical expression is derived for the figure of merit J/Pd associated with these waves. This is coupled with a ray tracing code, allowing the calculation of the total current generated per unit of incident power in realistic tokamak conditions. The resuts show that the electron Bernstein waves can drive substantial currents even at very low electron temperatures.

2548 **(INPE—4092) Kinetic effects in the propagation of ion-acoustic negative solitons in plasmas with negative ions.** Roberto, M. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Dec 1986. 174p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87703583/JAW.

The existence of ion-acoustic negative (rarefactive) solitons in plasmas was experimentally verified and explained by means of the Korteweg-de Vries equation, obtained from a fluid model. The experimental results obtained in a double-plasma machine of the Institute for Space Research, however, have provided values of Mach number larger than predicted by this simple model. In order to improve the analysis of the phenomenon, Kinetic effects resultant from the occurrence of reflected electrons and trapped ions in the soliton potential were considered, using the theory of Sagdeev potential. For the description of the negative ion dynamics the fluid model treatment was preserved. It was verified that the effects of the finite temperature and trapping of the positive ions modify the results predicted by the simple KdV model in such a way that the Mach number is reduced as the ion temperature increases. It was shown that reflection of electrons is consistent with the large experimental values of Mach number.

2549 **(IPPJ—798) Optimum condition of TPD-I recombining helium plasma for VUV coherent lasing action.** Furukane, Utaro; Tsuji, Yasumasa; Oda, Toshiatsu. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703593/JAW.

The optimum conditions of initial electron density and temperature, decay time, flow velocity, and plasma shape for the continuous VUV coherent laser oscillation are presented together with explanation of the population inversion mechanism in the recombining plasma of TPD-I, which consists basically of two parts; the discharge region with the cathode at the center of the cusped magnetic field and the plasma column region with the axial magnetic field. According to calculations, the initial plasma of the extremely high temperature and density is not necessarily required for the continuous coherent VUV wavelength laser oscillation. The continuous coherent laser of wavelength 164 nm which corresponds to the transition n = 3 -> 2 in H/sub e//sup +/ ion will be oscillated if the initial steady state extremely thin sheet plasma flow with the electron density of 1.28 x 10/sup 15/ — 1.28 x 10/sup 16/ cm/sup -3/ and with high speed of 2. x 10/sup 6/ cm/sec are cooled down to 0.2 eV with the decay time 10/sup -7/ — 10/sup -8/ sec.

2550 **(IPPJ—799) Implicit particle simulation of electromagnetic plasma phenomena.** Kamimura, T.; Montalvo, E.; Barnes, D.C.; Leboeuf, J.N.; Tajima, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703594/JAW.

A direct method for the implicit particle simulation of electromagnetic phenomena in magnetized, multi-dimensional plasmas is developed. The method is second-order accurate for $\omega\Delta t < 1$, with ω a characteristic frequency and time step Δt. Direct time integration of the implicit equations with simplified space differencing allows the consistent inclusion of finite particle size. Decentered time differencing of the Lorentz force permits the efficient simulation of strongly magnetized plasmas. A Fourier-space iterative technique for solving the implicit field corrector equation, based on the separation of plasma responses perpendicular and parallel to the magnetic field and longitudinal and transverse to the wavevector, is described. Wave propagation properties in a uniform plasma are in excellent agreement with theoretical expectations. Applications to collisionless tearing and coalescence instabilities further demonstrate the usefulness of the algorithm.

2551 **(IPPJ—801) Self-consistent modeling of a quasi-steady state compact torus evolving to ignition.** Hirano, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1986. 100p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703595/JAW.

Self-consistent modeling shows FRC has strong possibility to be evolved into ignited state of advanced fuel cycle. Analyses have been pursued using general basic equation sets describing an axisymmetric toroidal system under quasi-steady state, which have been derived from moments of the Boltzmann equation to be applied to FRC and spheromak. Transient behaviors are studied by similarity solution existing if plasma is heated up exclusively by injected beams. The key idea leading to simplify the analysis is in beam injection of different charge state in counter way in order to cancel out the net beam current keeping the beam generated emf finite. Using the similarity solutions we studied scenarios and requirements for FRC and spheromak to be evolved into ignited state. If plasma heating power is large enough as $<\beta>$ reaches to almost unity, the plasma is found to set in very peculiar state or to gain 'homeostasis', such that tau/sub E/ becomes independent of internal local properties like anomalous transport but dependent only on two externally adjustable quantities: averaged plasma heating power density and external field strength. High heating power by fusion burn at ignition is more than sufficient to fall the plasma into such state. It is indicated that $<\beta>$ — 1 is a very important requirement for an actual fusion reactor because not only current driving power and cyclotron loss are almost eliminated but also instabilities such as the tilting mode and the thermal instability due to fusion burn are stabilized.

2552 **(IPPJ—802) Tilt stability of field-reversed configurations.** Ishida, Akio; Momota, Hiromu. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703596/JAW.

By means of the two-fluid model in which the ion fluid is rigidly rotating with finite temperature and the electron fluid is at rest in equilibrium, the internal tilt stability of a field-reversed configuration (FRC) is studied theoretically. In contrast with previous theoretical studies, it is found that the elongated FRCs can be stabilized when both the elongation and scale factors are suitably chosen. Comparison of the present results with the experiments is made.

2553 (IPPJ—818, pp 13-20) **Monte Carlo particle simulation and finite-element techniques for tandem mirror transport.** Rognlien, T.D.; Cohen, B.I.; Matsuda, Y.; Stewart, J.J. Jr. (California Univ., Livermore, USA. Lawrence Livermore National Lab.). Mar 1987. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88780008/JAW. (CONF-8509216—).

From US-Japan workshop on advanced plasma modeling; Nagoya, Japan (24 Sep 1985).

A description is given of numerical methods used in the study of axial transport in tandem mirrors owing to Coulomb collisions and rf diffusion. The methods are Monte Carlo particle simulations and direct solution to the Fokker-Planck equations by finite-element expansion.

2554 (IPPJ—818, pp 21-60) **Hot electron formation in thermal barrier region of tandem mirror GAMMA 10.** Katanuma, I.; Kiwamoto, Y.; Sawada, K.; Miyoshi, S. (Tsukuba Univ., Sakura, Ibaraki, Japan). Mar 1987. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88780008/JAW. (CONF-8509216—).

From US-Japan workshop on advanced plasma modeling; Nagoya, Japan (24 Sep 1985).

We have studied the hot electron build-up by the second harmonic electron cyclotron resonance heating in the thermal barrier region of tandem mirror GAMMA 10 by using a Fokker-Planck code with self-consistent potential profile taken into account. We have found two phases in the evolution of hot electron population and the potential profile. In the first phase where the RF diffusion is dominant quick increase of the hot electron density and that of the mean energy are observed. No further increase in the mean energy is observed thereafter. The potential is the deepest during the first phase. The second phase starts in the mean-free-time of the pitch angle scattering of hot electrons on cold electrons and ions. In this phase the hot electron population increases in the rate of the pitch angle scattering. The potential dip shallows due to the accumulation of pitch angle scattered passing ions. This observation indicates the necessity of the ion pumping for maintaining the negative potential at the thermal barrier.

2555 (IPPJ—818, pp 69-75) **3D study of spinning spheromak.** Hayashi, Takaya; Sato, Tetsuya. (Hiroshima Univ., Japan. Inst. for Fusion Theory). Mar 1987. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88780008/JAW. (CONF-8509216—).

From US-Japan workshop on advanced plasma modeling; Nagoya, Japan (24 Sep 1985).

The spin-stabilization of the tilt of the spheromak plasma confined by an external magnetic field is investigated by means of a 3D magnetohydrodynamic simulation. The spinning spheromak-equilibrium is dynamically created by giving a spinning speed as high as about Mach one of the poloidal Alfven velocity and simultaneously increasing the magnitude of the external field. The life time of the spheromak is thereby remarkably increased. However, a new, presumably pressure-driven, instability is induced by the spin motion, which after all determines the lifetime. The results are indicating that the spinning spheromak, if practically created, can be a good candidate for a feasible confinement configuration.

2556 (IPPJ—818, pp 181-215) **Gyrokinetic particle simulation model.** Lee, W.W. (Princeton Univ., NJ, USA. Plasma Physics Lab.). Mar 1987. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88780008/JAW. (CONF-8509216—).

From US-Japan workshop on advanced plasma modeling; Nagoya, Japan (24 Sep 1985).

A new type of particle simulation model based on the gyrophase-averaged Vlasov and Poisson equations is presented. The reduced system, in which particle gyrations are removed from the equations of motion while the finite Larmor radius effects are still preserved, is most suitable for studying low-frequency microinstabilities in magnetized plasmas. The resulting gyrokinetic plasma is intrinsically quasineutral for λ/sub D/ << rho/sub s/ [= rho/sub i/(T/sub e//T/sub i/)/sup 1/2/]. Thus, without the troublesome space charge waves in the simulation, we can afford to use much larger time steps (ω/sub H/Δt approx < 1) and grid spacings (Δx sub(perpendicular/rho/sub s/ approx < 1) at a much reduced noise level than we would have for conventional particle codes, where ω/sub H/ = (k sub(parallel)/k sub(perpendicular))(λ/sub D//rho/sub s/)ω/sub pe/, and k sub(parallel) << k sub(perpendicular). Furthermore, it is feasible to simulate an elongated system (L sub(parallel) >> L sub(perpendicular)) with a three dimensional grid using the present model without resorting to the usual mode expansion technique, since there is essentially no restriction on the size of Δx sub(parallel) in a gyrokinetic plasma. The new approach also enables us to further separate the time and spatial scales of the simulation from those associated global transport through the use of multiple spatial scale expansion. Thus, the model can be a very efficient tool for studying anomalous transport problems related to steady-state drift-wave turbulence in magnetic confinement devices. It can also be applied to other areas of plasma physics.

2557 (IPPJ—818, pp 217-238) **Implicit particle simulation of magnetized plasmas.** Kamimura, T.; Abe, Y.; Barnes, D.C.; Leboeuf, J.N.; Tajima, T. (Nagoya Univ., Japan. Inst. of Plasma Physics). Mar 1987. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88780008/JAW. (CONF-8509216—).

From US-Japan workshop on advanced plasma modeling; Nagoya, Japan (24 Sep 1985).

An accurate, direct method for the implicit particle simulation of magnetized, multi-dimensional plasmas is developed. Second-order temporal accuracy is attained for ωΔt < 1, with ω a characteristic frequency and time step Δt. A time decentered particle push permits the efficient simulation of strongly magnetized plasmas. Numerical results for ion-acoustic fluctuations and for an unstable gravitational interchange demonstrate the usefulness of the method applied to low frequency plasma phenomena.

2558 (IPPJ—818, pp 261-281) **Resonant ion acceleration by collisionless magnetosonic shock waves.** Ohsawa, Yukiharu. (Nagoya Univ., Japan. Inst. of Plasma Physics). Mar 1987. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88780008/JAW. (CONF-8509216—).

From US-Japan workshop on advanced plasma modeling; Nagoya, Japan (24 Sep 1985).

Resonant ion acceleration (the υ/sub p/ x B acceleration) in laminar magnetosonic shock waves is studied by theory and simulation. Theoretical analysis based on a two-fluid model shows that, in laminar shocks, the electric field strength in the direction of the wave normal is about (m/sub i//m/sub e/)/sup 1/2/ times larger for quasi-perpendicular shocks than that for the quasi-parallel shocks, which is a reflection of the fact that the width of quasi-perpendicular shocks is much smaller than that of the quasi-parallel shocks. Trapped ions can be accelerated up to the speed about υ/sub A/(m/sub i//m/sub e/)/sup 1/2/(M/sub A/-1)/sup 3/2/ in quasi-perpendicular shocks. Time evolution of self-consistent magnetosonic shock waves is studied by using a 2 - 1/2 dimensional fully relativistic, fully electromagnetic particle simulation with full ion and electron dynamics. Even a low-Mach-number shock wave can significantly accelerate trapped ions by the υ/sub p/ x B acceleration. The resonant ion acceleration occurs more strongly in quasi-perpendicular shocks, because the magnitude of this acceleration is proportional to the electric field strength.

2559 (IPPJ—818, pp 283-298) **Plasma simulation by macroscale, electromagnetic particle code and its application to current-drive by relativistic electron beam injection.** Tanaka, Motohiko; Sato, Tetsuya. (Hiroshima Univ., Japan. Inst. for Fusion Theory). Mar 1987. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88780008/JAW. (CONF-8509216—).

From US-Japan workshop on advanced plasma modeling; Nagoya, Japan (24 Sep 1985).

A new implicit macroscale electromagnetic particle simulation code (MARC) which allows a large scale length and a time step in multi-dimensions is described. Finite mass electrons and ions are used with relativistic version of the equation of motion. The electromagnetic fields are solved by using a complete set of Maxwell equations. For time integration of the field equations, a decentered (backward) finite differencing scheme is employed with the predictor - corrector method for small noise and super-stability. It is shown both in analytical and numerical ways that the present scheme efficiently suppresses high frequency electrostatic and electromagnetic waves in a plasma, and that it accurately reproduces low frequency waves such as ion acoustic waves, Alfven waves and fast magnetosonic waves. The present numerical scheme has currently been coded in three dimensions for application to a new tokamak current-drive method by means of relativistic electron beam injection. Some remarks of the proper macroscale code application is presented in this paper.

2560 (IPPJ—818, pp 299-314) **Hybrid code simulation on mode conversion in the second harmonic ICRF heating.** Sakai, Kazuo; Takeuchi, Satoshi; Matsumoto, Michio; Sugihara, Ryo. (Yamanashi Univ., Kofu, Japan). Mar 1987. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88780008/JAW. (CONF-8509216—).

From US-Japan workshop on advanced plasma modeling; Nagoya, Japan (24 Sep 1985).

ICRF second harmonic heating of a single-species plasma is studied by using a 1 - 1/2 dimensional quasi-neutral hybrid code. Mode conversion, transmission and reflection of the magnetosonic waves are confirmed, both for the high- and low-field-side excitations. The ion heating by waves propagating perpendicularly to the static magnetic field is also observed.

2561 **(IPPJ—818) Proceedings of the US-Japan workshop on advanced plasma modeling.** (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1987. vp. (CONF-8509216—). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88780008/JAW.

From US-Japan workshop on advanced plasma modeling; Nagoya, Japan (24 Sep 1985).

Separate abstracts were prepared for the individual papers. (WRF)

2562 **(IPPJ—827) Steady state theta pinch concept for slow formation of FRC.** Hirano, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750294/JAW.

A steady state high beta plasma flow through a channel along the magnetic field increasing downstream can be regarded as a "steady state theta pinch", because if we see the plasma riding on the flow we should observe very similar process taking place in a theta pinch. Anticipating to produce an FRC without using very high voltage technics such as the ones required in a conventional theta pinch, we have studied after the analogy a "steady state reversed field theta pinch" which is brought about by steady head-on collision of counter plasma streams along the channel as ejected from two identical co-axial plasma sources mounted at the both ends of the apparatus. The ideal Poisson and shock adiabatic flow models are employed for the analysis of the steady colliding process. It is demonstrated that an FRC involving large numbers of particles is produced only by the weak shock mode which is achieved in case energetic plasma flow is decelerated almost to be stagnated through Poisson adiabatic process before the streams are collided.

2563 (IPPJ-AM—50, pp 94-99) **Plasma surface interactions in compact ignition devices.** Ulrickson, M. (Princeton Univ., NJ). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Conditioning of the TFTR Bumper Limiter with Helium discharges has resulted in a substantial reduction of the recycling coefficient during deuterium operation. Values of tau/sup *//sub rho/ = tau/sub rho//(1-R) as small as 150ms have been observed. Using absolute H/sub d/ measurements a recycling coefficient of 0.5 is inferred. The effect is not well understood but may be due to ion induced desorption. Anticipated heat loads in CIT are also presented.

2564 **(IPPJ-DT—133) Poloidal field measurement by means of Faraday rotator coupled with optical fibers on the JIPP T-IIU tokamak.** Nishizawa, A.; Fujita, J. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1986. 16p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703597/JAW.

A magnetic field sensor of a near infrared Faraday rotator supplied by Mitsubishi Electric Corporation has been used for the measurement of the poloidal field on JIPP T-IIU. The poloidal field thus measured agrees within 2 percent in accuracy with the value calculated from the plasma current which is measured with two pairs of magnetic probe calibrated by a Rogowski coil. The measurement error of poloidal field was mainly caused by the output noise of the signal amplifier. The errors due to this noise were 12 and 8.4 percent in the observed ranges of 0.4 and 1.0 k gauss, respectively. Other factors of the measurement error are also discussed in this paper. As a result, much information was obtained on the applicability of Faraday rotator in the poloidal field measurement on tokamaks.

2565 **(JAERI-M—87-080) Empirical scaling of energy confinement time of L-mode and optimized mode and some consideration of reactor core plasma in tokamak.** Shimomura, Yasuo; Suzuki, Norio; Sugihara, Masayoshi; Tsuda, Takashi; Odajima, Kazuo; Tsunematsu, Toshihide. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750055/JAW.

Empirical scalings of energy confinement time for both L-mode and optimized mode in tokamak are reduced mainly from JAERI results. The L-mode scaling has strong dependence on plasma size rather than plasma current and the optimized scaling has strong dependence on plasma size and toroidal field or plasma current. Based on the scaling, characteristics of reactor core plasmas in tokamaks are discussed.

2566 **(JAERI-M—87-094) Transport analysis of JT-60 plasma by drift wave turbulence model.** Shirai, Hiroshi; Hirayama, Toshio; Shimizu, Katsuhiro; Takizuka, Tomonori; Azumi, Masafumi. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750305/JAW.

Characteristics of JT-60 plasma in both ohmic and neutral beam heating phase are numerically studied by using the one dimensional tokamak transport code with thermal conductivities based on the drift wave turbulence model. The numerical results show good agreement with experimental data in the medium electron density range n-bar/sub e/ — 4 x 10/sup 19/ m/sup -3/ both for ohmic and neutral beam heating cases. On the contrary, the model underestimates the plasma temperatures in the low electron density range because of the strong dependence of thermal conductivities on electron temperature, and can not reproduce high temperature plasmas.

2567 **(JAERI-M—87-100) Integration of multi-channel magnetic signals in the JFT-2M.** Mori, Masahiro. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 16p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750308/JAW.

Multi-channel magnetic data measured by pick-up coils have been collected with data acquisition system in order to determine plasma equillibrium parameters in the JFT-2M, and such data are integrated numerically. Passive filter and superposition of 50 Hz triangular wave on measured signals are successful to reduce error which comes from digital errors. In this paper these system and their performance are described.

2568 **(JET-R—86-10) Alpha particle diagnostics. Progress report, December 1985-June 1986.** Hughes, T.P. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1986. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87752960/JAW.

The paper concerns the alpha particles produced during the D-T phase in JET fusion reactions, and the velocity distribution function fα(V,t) of these particles in the plasma. Alpha particle dynamics in plasmas are discussed, along with the evolution of the alpha particle distribution function, alpha-particle driven instabilities, and a summary of methods proposed for alpha particle diagnostics. A new technique is proposed for determining the spectrum of small-angle, Thomson-scattered 10.6μm radiation. Finally, Thomson scattering of gyrotron radiation is considered.

2569 **(JET-R—87-01) Heat pulse propagation studies in JET.** Tubbing, B.J.D.; Lopes Cardozo, N.J. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1987. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87752954/JAW.

Heat pulse propagation (HPP) studies in JET have been carried out using a twelve-channel electron cyclotron emission grating (ECE) polychromator. Emphasis is placed on the behaviour of the heat pulse under strong auxiliary heating. The conventional diffusive model for the data-interpretation has been extended so as to take into account the source- and sink terms in the electron power balance equation. It is concluded that the heat pulse is governed by

an incremental heat diffusivity, which is related to the incremental confinement time. Experimental results which were obtained during operation of JET are presented, including values of HPP during ohmic heating and HPP during auxiliary heating. These experimental results are discussed with respect to the incremental heat diffusivity. Finally the results of this work are considered in relation to the study of anomalous transport in tokamaks.

2570 **(Juel—2115) Two-zone model for the transport of wall released impurities in the edge plasma of a limiter tokamak.** Claassen, H.A.; Gerhauser, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik). Feb 1987. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753287/JAW.

The transmission of a Gaussian metal impurity pulse uniformly injected from the torus wall is studied within a two-zone plasma model, which separates the plasma into scrape-off layer and plasma core and allows for discontinuous changes of the plasma parameters at the separatrix. The plasma parameters are supposed to ensure a collision dominated scrape-off plasma, in which case we may restrict the solution of the transport equations to its zero order approximation.

2571 **(KEK—86-11) Absolute photoionization cross sections for argon, krypton, and xenon in the VUV regions.** Yagishita, Akira. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Feb 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750284/JAW.

Absolute photoionization cross sections for argon, krypton, and xenon have been measured in the region between 350 A and the onset of photoionization. The standard deviations of the absolute values have been reduced to between +-1.4% and +-2.5% in the longer wavelength regions.

2572 **(LA-UR—87-2854) Dynamic processes in field-reversed-configuration compact toroids.** Rej, D.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 21p. (CONF-870908—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014756/JAW.

From Course and workshop on physics of mirrors, reversed field pinches and compact tori; Varenna, Italy (1 Sep 1987).

In this lecture, the dynamic processes involved in field-reversed configuration (FRC) formation, translation, and compression will be reviewed. Though the FRC is related to the field-reversed mirror concept, the formation method used in most experiments is a variant of the field-reversed Θ-pinch. Formation of the FRC eqilibrium occurs rapidly, usually in less than 20 μs. The formation sequence consists of several coupled processes: preionization; radial implosion and compression; magnetic field line closure; axial contraction; equilibrium formation. Recent experiments and theory have led to a significantly improved understanding of these processes; however, the experimental method still relies on a somewhat empirical approach which involves the optimization of initial preionization plasma parameters and symmetry. New improvements in FRC formation methods include the use of lower voltages which extrapolate better to larger devices. The axial translation of compact toroid plasmas offers an attractive engineering convenience in a fusion reactor. FRC translation has been demonstrated in several experiments worldwide, and these plasmas are found to be robust, moving at speeds up to the Alfven velocity over distances of up to 16 m, with no degradation in the confinement. Compact toroids are ideal for magnetic compression. Translated FRCs have been compressed and heated by imploding liners. Upcoming experiments will rely on external flux compression to heat a translater FRC at 1-GW power levels. 39 refs.

2573 **(LA-UR—87-3106) Transport simulations of the oscillating field current drive experiment in the ZT-40M reversed field pinch.** Scardovelli, R.A.; Nebel, R.A.; Werley, K.A.; Miley, G.H. (Los Alamos National Lab., NM (USA); Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1987. Contract W-7405-ENG-36. 10p. (CONF-870908—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000538/JAW.

From Course and workshop on physics of mirrors, reversed field pinches and compact tori; Varenna, Italy (1 Sep 1987).

Oscillating Field Current Drive (OFCD) is based on the premise that in order to sustain a relaxing Reversed Field Pinch (RFP) plasma, one needs only to supply magnetic helicity at the same rate it is consumed. The purpose of this work is to try to better understand the possible mechanisms underlying these relaxations within the context of different kinds of resistive MHD instabilities.

2574 **(LBL—23709) H^- formation process in a multicusp ion source.** Leung, K.N.; Kunkel, W.B. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 10p. (CONF-870787—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000209/JAW.

From International Atomic Energy Agency technical committee meeting on negative ion beam sources; Culham, UK (15 Jul 1987).

In recent years, H^- ions have been found important applications in high energy accelerators and in neutral beam heating of fusion plasmas. There are different techniques for producing the H^- or D^- ions. The most attractive scheme is the direct extraction of H^- ions from a hydrogen discharge. This technique requires no cesium and it utilizes the existing large area positive ion source technology. This paper investigates this techniques. 14 refs.

2575 **(LBL—23711) Volume production of Li^- in a multicusp ion source.** Walther, S.R.; Leung, K.N.; Kunkel, W.B. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 8p. (CONF-870787—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000458/JAW.

From International Atomic Energy Agency technical committee meeting on negative ion beam sources; Culham, UK (15 Jul 1987).

A neutral 100kev Li beam has been used as a diagnostic tool for determining current, plasma density, and magnetic pitch angle on the Texas EXperimental Tokamak. Scale up of this diagnostic for the Tokomak Fusion Test Reactor would require use of a Li^- beam because of the inefficiency of neutralizing Li^+ at the high energies required. This paper discusses effects to generate Li^- beams from a plasma discharge. 8 refs.

2576 (N—87-25884, pp 11) **Transverse diffusion of electrons in a magnetoplasma.** Mcintyre, B. Jun 1987. NTIS, PC A13/MF A01. (NASA-CR—171984-VOL-2; NAS—1.26:171984-VOL-2).

In National Aeronautics and Space Administration (NASA)/ American Society for Engineering Education (ASEE) summer faculty fellowship program, 1986, Volume 2.

Plasma density and temperature profiles were measured for plasma electrons which were generated by a plasma source and ionization from a 1 kev electron beam. Electron plasma parameters were measured with a cylindrical Langmuir probe which was moved perpendicular to the axis of the beam and field. Electron densities decreased exponentially from the beam center and the decay constant varied with magnetic field in accordance with the Bohm theory of cross field diffusion. This enhanced diffusion effect due to instabilities generated by the electron beam is orders of magnitude larger than that due to particle collisions.

2577 (N—87-26531, pp vp) **Plasma simulation using the massively parallel processor.** Lin, C.S.; Thring, A.L.; Koga, J.; Janetzke, R.W. Jul 1987. NTIS, PC A13/MF A01. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—).

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

Two dimensional electrostatic simulation codes using the particle-in-cell model are developed on the Massively Parallel Processor (MPP). The conventional plasma simulation procedure that computes electric fields at particle positions by means of a gridded system is found inefficient on the MPP. The MPP simulation code is thus based on the gridless system in which particles are assigned to processing elements and electric fields are computed directly via Discrete Fourier Transform. Currently, the gridless model on the MPP in two dimensions is about nine times slower that the gridded system on the CRAY X-MP without considering I/O time. However, the gridless system on the MPP can be improved by incorporat-

ing a faster I/O between the staging memory and Array Unit and a more efficient procedure for taking floating point sums over processing elements. The initial results suggest that the parallel processors have the potential for performing large scale plasma simulations.

2578 **(PPPL—2454) Fission-detector determination of D-D triton burnup fraction in beam-heated TFTR [Tokamak Fusion Test Reactor] plasmas.** Jassby, D.L.; Hendel, H.W.; Barnes, C.W.; Bosch, S.; Cecil, F.E.; McCune, D.C.; Nieschmidt, E.B.; Strachan, J.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1987. Contract AC02-76CH03073. 9p. (CONF-870629—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000120/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

After the end of a neutral-beam injection pulse into a low-density TFTR plasma, once the beam-injected deuterons have thermalized, the neutron emission is dominated by the 14-MeV neutron production from D-D triton burnup. Ordinary fission detectors can measure the 14-MeV emission rate, which can be extrapolated back in time to estimate the equilibrium triton burnup fraction. The fractional burnup determined by this method is in the range of 0.3 to 1.5% for TFTR discharges to date, and is consistent with classical confinement and slowing down. 10 refs., 3 figs.

2579 **(UCB/ERL-M—87/51) The Pierce diode with an external circuit: I, Simulations in the linear regime.** Lawson, W.S. (California Univ., Berkeley (USA). Electronics Research Lab.). 22 Jul 1987. Contract FG03-86ER53220. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000413/JAW.

The linear theory for the eigenfrequencies of the extended Pierce diode for resistive, capacitive, and inductive external circuits is tested via computer simulation with the PDW1 code, and is verified to within the accuracy of the simulation (between 1% and .01% depending on the circumstances). The simulations were remarkably inexpensive in terms of computer time, and could have been performed on a personal computer.

2580 **(UCB/ERL-M—87/62) Electrostatic potential formation due to a large dip in the magnetic field with application to FRC confinement.** Parker, S.E. (California Univ., Berkeley (USA). Electronics Research Lab.). 10 Sep 1987. Contract FG03-86ER53220. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000414/JAW.

Electrostatic effects may explain the enhanced plasma confinement observed in the open field line region of field-reversed configurations (FRC). The formation of electrostatic potentials due to nonuniform magnetic fields are being studied and this type of phenomenon is being modeled using particle simulation. The two dimensional (x,y) electrostatic particle code, ES2 has been used to study the formation of electrostatic potentials due to magnetic wells and peaks with an injected flux of well magnetized electrons and weakly magnetized ions. These results are being used to help interpret the electrostatic potential contours outside the separatrix of a FRC, which are really cylindrical, (r,z). These potentials may explain the anomalously high ion confinement in the FRC edge layer.

2581 **Characteristics of compact solid-target charge exchange analyzers for energetic ion diagnostics on tokamaks.** Beiersdorfer, P.; Roquemore, A.L.; Kaita, R. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **58**: No. 11, 2092-2098(Nov 1987).

Compact electrostatic charge exchange analyzers (18 x 18 x 13 cm) have been constructed for installation in areas of high magnetic fields and restricted access near tokamak fusion devices. The analyzers employed carbon stripping foils, and have been calibrated for proton and deuteron energies between 1 and 70 keV. They have been successfully used to study charge exchange losses in auxiliary-heated tokamak plasmas and were found to be ideally suited to supplement the larger and more complex gas-cell analyzers by providing additional spatial and temporal information at a modest effort and cost.

2582 **Inverse moments equilibria for helical anisotropic systems.** Cooper, W.A.; Hirshman, S.P.; Depassier, M.C. (Centre de Recherches en Physique des Plasmas, Association Euratom: Confederation Suisse, Ecole Polytechnique Federale de Lausanne, 21, Av. des Bains, CH-1007 Lausanne, Switzerland). *Physics of Fluids;* **30**: No. 11, 3532-3539(Nov 1987).

An energy functional is devised for magnetic confinement schemes that have anisotropic plasma pressure. The minimization of this energy functional is demonstrated to reproduce components of the magnetohydrodynamic (MHD) force balance relation in systems with helical symmetry. An iterative steepest descent procedure is applied to the Fourier moments of the inverse magnetic flux coordinates to minimize the total energy and thus generate anisotropic pressure MHD equilibria. Applications to straight ELMO Snaky Torus (NTIS Document No. DE-84002406) configurations that have a magnetic well on the outermost flux surfaces have been obtained.

2583 **Transient electrostatic potentials driven by short-pulse electron cyclotron heating.** Lichtenberg, A.J.; Lieberman, M.A.; Cohen, R.H. (Department of Electrical Engineering and Computer Sciences and the Electronics Research Laboratory, University of California, Berkeley, California 94720). *Physics of Fluids;* **30**: No. 11, 3540-3547(Nov 1987).

Electrons heated in a local resonance zone of a magnetic well created either by a linear mirror or a finite aspect ratio torus are considered. If the heating has sufficient strength to drive a significant nonisotropy in the electron distribution function, an electrostatic potential variation along a field line is developed to maintain charge neutrality. The buildup of this space varying potential for times shorter than ion-transit times is determined analytically, and a limit to the number of electrons within the well that can be heated is found. The subsequent evolution of the potential on ion-transit and collision time scales is also determined. The theory is applied both to large mirror ratio devices characteristic of magnetic mirror confinement and to small mirror ratio devices characteristic of tokamaks. In the former configuration the theory is compared to experimental observations of potential buildup and decay in the multiple-mirror experiment (MMX) device [Phys. Fluids 29, 1208 (1986)] and shown to be consistent with the experiments.

2584 **Harmonic overlap in electron-cyclotron current drive at high T/sub e/.** Smith, G.R.; Cohen, R.H.; Mau, T.K. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids;* **30**: No. 11, 3633-3635(Nov 1987). Contract W-7405-ENG-48.

The relativistic wave—particle resonance condition imposes a harmonic-overlap constraint on electron-cyclotron current drive. Specifically, for fundamental cyclotron resonance the current-drive efficiency cannot be increased by raising the minimum resonant energy ϵ_1 above about 115 keV. A limiting efficiency corresponding to an even lower ϵ_1 follows for microwave beams with realistic width and angular divergence.

2585 **Neoclassical flux-friction relations in arbitrary closed-end plasmas.** Lau, Y.T. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **30**: No. 11, 3517-3525(Nov 1987).

By following the moment approach of neoclassical transport theory and introducing a vector field D determined by the magnetic field, flux-friction relations in arbitrary closed-end plasmas are derived. Unlike the conventional ones, which are based on the flux coordinates, the new formulas can be used with any coordinate system. They are therefore more convenient for systems with complicated magnetic axes, such as DRAKON's [in Controlled Fusion and Plasma Physics, 1981, Proceedings of the 10th European Conference, Moscow (European Physical Society, Budapest, 1981), Vol. 1, paper E-8; in Plasma Physics and Controlled Nuclear Fusion Research, 1982, Proceedings of the 9th International Conference, Baltimore (IAEA, Vienna, 1983), Vol. 3, p. 159], for which coordinates that follow the magnetic axes are more natural than the

flux coordinates. As a simple application, the Pfirsch—Schlueter fluxes are obtained for arbitrary closed-end plasmas.

2586 **Kelvin—Helmholtz instability and vortices in magnetized plasma.** Horton, W.; Tajima, T.; Kamimura, T. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **30**: No. 11, 3485-3495(Nov 1987).

Analytic theory and implicit particle simulations are used to describe the evolution of the Kelvin—Helmholtz instability and the plasma vortices driven by a nonuniform E x B flow velocity. Formulas for plasma convection arising from the self-consistent plasma electric field give the rate of anomalous momentum transport across the magnetic field. The momentum transport is shown to be controlled by the tilting angle of the elliptical vortex with respect to the direction of the parallel flow. Three stages of evolution are investigated and formulas for the final vortex state are given.

2587 **Stability of a one-dimensional plasma in slab geometry.** Jensen, T.H.; Thompson, W.B. (GA Technologies Inc., P. O. Box 85608, San Diego, California 92138). *Physics of Fluids;* **30**: No. 11, 3502-3505(Nov 1987).

Stability of a one-dimensional slab of plasma is considered for the simplest case of a static equilibrium with negligible pressure. A special class of deformations is considered that satisfies a magnetohydrodynamic (MHD) constraint except in a particular surface. These deformations, which resemble those considered for tearing modes, form a continuous path away from the equilibrium. The deformed configurations are not equilibria and their magnetic energies are, therefore, always larger than those of associated equilibria. It is shown that except for a special class of equilibria [previously discussed by Taylor, Phys. Rev. Lett. 33, 1139 (1974)] there exist deformations for which the magnetic energy is continuously decreasing, a result that is interpreted as showing that only this class is stable. The arguments, though asymptotic, are simple, essentially geometric, and do not require linearization. The results differ from those of the traditional linear tearing mode calculation [Furth, Killeen, and Rosenbluth, Phys. Fluids 6, 459 (1963)], making the class of stable equilibria smaller.

2588 **Neoclassical kernel for electron cyclotron wave driven current in tokamaks.** Chan, V.S. (GA Technologies Inc., San Diego, California 92138). *Physics of Fluids;* **30**: No. 11, 3526-3531(Nov 1987).

When electron cyclotron wave propagation can be treated by geometric optics, the local current drive efficiency can be expressed as an integral. A kernel for the integral that takes into account important neoclassical effects such as particle trapping and orbit modification is derived using a momentum-conserving collision operator. For absorption at the low field side of a tokamak, trapping effects reduce the efficiency significantly, while for absorption at the high field side, modification of passing particle orbits also diminishes the driven current, although to a lesser extent.

2589 **Warm electron-driven whistler instability in an electron-cyclotron-resonance heated, mirror-confined plasma.** Garner, R.C.; Mauel, A.M.E.; Hokin, B.S.A.; Post, R.S.; Smatlak, D.L. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **59**: No. 16, 1821-1824(19 Oct 1987).

The whistler electron microinstability has been observed in the Constance B quadrupole-mirror, electron-cyclotron-resonance heated plasma. Experimental evidence indicates that the warm-electron component (2 keV) drives the instability while the hot-electron component (400 keV) is stable. Dispersion-relation calculations using a new distribution function (electron-cyclotron-resonance heated distribution) to model the warm-electron component are in agreement with this experimental result.

2590 **Self-organization of electrostatic turbulence in a cylindrical plasma.** Hasegawa, A.; Wakatani, M. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **59**: No. 14, 1581-1584(5 Oct 1987).

On the basis of theory and computer simulations we show that electrostatic turbulence in a cylindrical plasma with magnetic shear and curvature self-organizes to form a macroscopic potential phi which depends only on the radial coordinate r and is given by $\mathrm{phi}(r)=aJ_0(pr)+C_1r^2+C_2$ where C_1 and C_2 are functions of a constant p. A unique feature of the potential is the existence of a coaxial $\mathrm{phi}(r_0) = 0$ surface at $r_0 \approx 0.7a$, where a is the radius of the cylinder. This surface is found to be fairly rigid and is considered to inhibit radial particle transport.

2591 **Some practical considerations involving spectral representations of 3D plasma equilibria.** Attenberger, S.E.; Houlberg, W.A.; Hirshman, S.P. (Computing and Telecommunications Division, Oak Ridge National Laboratory, Oak ridge, Tennessee 37831). *Journal of Computational Physics;* **72**: No. 2, 435-448(Oct 1987). Contract AC05-84OR21400.

For describing magnetically confined toroidal plasmas, it is convenient in some instances to use a cylindrical coordinate system whose origin is on the major axis of the torus and in others to use a "flux coordinate" system bound to the magnetic flux which is embedded in the plasma. A good estimate of the flux surface geometry is available in spectral form in many cases, permitting a simple transformation from flux coordinates to cylindrical coordinates. A modified Newton iteration is described for performing the "inverse" transformation from cylindrical coordinates coordinates to flux coordinates. An accurate technique for radial spline interpolation of the spectral coefficients is given which is particularly useful for computing magnetic fields near the magnetic axis. Given a spectral representation of the plasma it is possible to track a chord through the plasma, determining in sequence its intersections with a given set of flux surfaces. This technique is the starting point for many calculations including neutral beam heating, pellet fueling, evaluation of absorption or plasma sources along the lines-of-sight of detectors, etc. An efficient algorithm for performing this calculation is given. These algorithms permit the determination of plasma "profiles" from chordal data by a straightforward least-squares technique, without any restrictions on the orientation of the chords. The method shown is contrasted to those based on generalized Abel transforms. copyright 1987 Academic Press, Inc.

2592 **Radiative properties of hot dense matter III.** Rozsnyai, B.; Hooper, C.; Cauble, R.; Lee, R.; Davis, J. Teaneck, NJ; World Scientific Pub. Co. (1987). 566p. (CONF-8510172—). World Scientific Pub. Co., 687 Hartwell Street, Teaneck, NJ 07666.

From 3. international conference and workshop on radiative properties of hot dense matter; Williamsburg, VA, USA (14 Oct 1985).

This book presents the papers given at a conference on the use of radiation in plasma research. Topics considered at the conference included bremsstrahlung, laser-produced plasma, x-ray spectroscopy, non-thermal effects in a hot dense plasma, x-ray emission from laser-produced plasma, argon puff gas soft x-ray lasers, photoionization and photorecombination cross sections in plasmas, radiation transport, equations of state, electrodynamics and plasma production.

2593 **Detector and energy analyzer for energetic-hydrogen in beams and plasmas.** Bastasz, R.J.; Hughes, R.C.; Wampler, W.R. (to Dept. of Energy). US Patent Application 6-925,590. 31 Oct 1986. 23p. Contract AC04-76DP00789. DE88000839 NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000839/JAW.

A detector for detecting energetic hydrogen ions and atoms ranging in energy from about 1 eV up to 1 keV in an evacuated environment includes a Schottky diode with a palladium or palladium-alloy gate metal applied to a silicon-dioxide layer on an n-silicon substrate. An array of the energetic-hydrogen detectors having a range of energy sensitivities form a plasma energy analyzer having a rapid response time and a sensitivity for measuring fluxes of energetic hydrogen. The detector is sensitive to hydrogen and its isotopes, but is insensitive to non-hydrogenic particles. The array of energetic-hydrogen detectors can be formed on a single silicon chip, with thin-film layers of gold metal applied in various thicknesses to successive detectors in the array. The gold layers serve as particle energy-filters so that each detector is sensitive to a different range of hydrogen energies.

2594 **Heating and compression of thermonuclear targets by laser beam.** Basov, N.G. New York, NY; Cambridge University Press (1986). 476p. Cambridge University Press, 32 East 57 St., New York, NY 10022.

This abridged edition contains the multi-beam laser system KAI/MAR and its diagnostic; investigation of strong shock waves by active optical diagnostics; investigation of the X-ray continuum emission from the plasma; the energy balance for spherically irradiated targets; diagnostics and its investigations; scattering of laser radiation in the vicinity of the n/sub c//4 density; the formation and dynamics of the plasma corona using spherical targets; investigation of the energy spectrum of superthermal particles emitted from a plasma; and an investigation of the state of the compressed core. This volume is a translation of the original Russian edition published in 1982. It describes the basic processes associated with laser thermonuclear synthesis. Experimental work done over the last 10 years with an emphasis on that done at the Lebedev Physical Institute in the USSR is described.

2595 **Plasmas and fluids.** Washington, DC; National Academy Press (1986). 336p. National Academy Press, 2101 Constitution Ave. NW, Washington, DC 20418.

Plasma and fluid physics includes the fields of fusion research and space investigation. This book discusses the most important advances in these areas over the past decade and recommends a stronger commitment to basic research in plasma and fluid physics. The book recommends that plasma and fluid physics be included in physics curriculums because of their increasing importance in energy and defense. The book also lists recent accomplishments in the fields of general plasma physics, fusion plasma confinement and heating, space and astrophysical plasmas, and fluid physics and lists research opportunities in these areas. A funding summary explains how research monies are allocated and suggests ways to improve their effectiveness.

7002 Fusion Power Plant Technology

REFER ALSO TO CITATION(S) 793, 1104, 1291, 1450, 1465, 1466, 1475, 2114, 2427, 2538, 2563, 2594, 2735, 2781

2596 **(AAEC/E—641) Measurement of the responses of small lithium glass scintillators to protons, deuterons and alpha particles.** Dalton, A.W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700085/JAW.

The application of lithium glass detectors to the measurement of the tritium production rate distribution in fusion blanket assemblies is under investigation at Lucas Heights. As a consequence of neutron-induced reactions within the glass detector, many charged particles are produced with energies ranging from zero to about 20 MeV, all of which produce scintillations. To isolate the signals arising from the tritium production reactions /sup 6/Li(n,α)T and /sup 7/Li(n,n'α)T within the glass, the characteristic responses of the glass to all charged particles are required. As part of this investigation, the response characteristics of thin lithium glass scintillators to protons, deuterons and alphas have been measured as a function of particle energy (0.8 to 2.7 MeV), lithium concentration (2.4 to 8.3 wt %) and lithium enrichment (95 wt % /sup 6/Li to 99.99 wt % /sup 7/Li).

2597 **(AAEC/E—642) Tritium breeding experiments in a fusion blanket assembly using a low-intensity neutron generator.** Dalton, A.W.; Woodley, H.J.; McGregor, B.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700086/JAW.

Experiments have been carried out to determine the accuracy with which tritium production rates (TPRs) can be measured in a fusion blanket assembly of non-spherical geometry by a non-central low intensity D-T neutron source (2x10/sup 10/ neutrons per second). The tritium production was determined for samples of lithium carbonate containing high enrichments of /sup 6/Li(96%) and /sup 7/Li(99.9%). The measured data were used to check the accuracy with which the TPRs could be numerically predicted using current nuclear data and calculational methods. The numerical predictions from tritium production from the /sup 7/Li samples agreed within the experimental errors of the measurements, but /sup 6/Li measurements which differ by more than 20 per cent from the predicted values were observed in the lower half of the assembly.

2598 **(ANU/TPP—86/03) Harmonic expansion for the magnetic field of the helical solenoid.** Dewar, R.L.; Gardner, H.J. (Australian National Univ., Canberra. Research School of Physical Sciences). Mar 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700100/JAW.

We discuss the boundary value problem for calculating the scalar magnetic potentials inside and outside of a helically symmetric solenoid. Under some circumstances the potentials can be expanded in infinite series of cylindrical harmonics. For a circular cross-section solenoid, we derive a Green's function integral representation of the series coefficients and calculate the radii of convergence of the series by a saddle point method. In some cases the cylinders of convergence can intersect the coil, so that there are physically accessible regions where the series fail to converge. Numerical evidence is presented to show that, even in some of these cases, the potentials can be accurately approximated by finite sums of cylindrical harmonics using boundary collocation.

2599 **(CEA-CONF—8868) Tritium recovery experiments in JRR-2/VOM.** Watanabe, H.; Kurasawa, T.; Vollath, D.; Roth, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Oct 1986. 5p. (CONF-8610214—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752912/JAW.

From International symposium on fusion reactor blanket and fuel cycle technology; Tokai-mura, Japan (27 Oct 1986).

The VOM experiments were conducted in the JRR-2 reactor in order to examine the tritium release behavior from Li_2O, $LiAlO_2$ and Li_4SiO_4. Various improvements in capsule design and the measurement apparatus were accomplished. The dominant chemical forms in a pure helium sweep gas was mainly HTO and T_2O. Tritium release was enhanced in deuterium bearing sweep gases and the chemical form was changed to DT and T_2. For the three breeding materials tested, the tritium release from Li_2O was the fastest followed by that of Li_4SiO_4.

2600 **(CEA-CONF—8869) Parameters governing tritium extraction rates from lithiated ceramics. The case of lithium aluminate.** Roth, E.; Botter, F.; Briec, M.; Rasneur, B.; Roux, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Oct 1986. 5p. (CONF-8610214—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87752913/JAW.

From International symposium on fusion reactor blanket and fuel cycle technology; Tokai-mura, Japan (27 Oct 1986).

Significant discrepancies between results of authors comparing tritium extraction rates from different lithiated ceramics are found in the literature. Recent results obtained at C.E.A., principally on lithium aluminates, show that, for a given ceramic, parameters other than textural (grain size, porosity, etc...) may play a predominant role. Enhancements of extraction rates have been induced by adding MgO to the solid or H_2 and CO to the sweep gas, but other factors, probably related to the surface condition of samples, may produce even greater effects. Results of investigations of the influence of exposure to air at given partial pressures of water vapor or of CO_2 show that strict preirradiation procedures must be adopted for preparation, storage and handling of ceramic tritium breeders.

2601 **(CLM-R—274) Investigations of the formability, weldability and creep resistance of some potential low-activation austenitic stainless steels for fusion reactor applications.** Bott, A.H.; Pickering, F.B. (UKAEA Culham Lab., Abingdon). Oct 1986. 29p. H.M. Stationery Office, London, price Pound5.00.

The formability, weldability and creep properties have been investigated for three high-manganese high-nitrogen austenitic stainless steels proposed as low-activation materials for fusion. The

alloys were found to possess adequate hot and cold workability, with marginally inferior stretch formability but slightly superior deep drawability relative to conventional austenitic steels. The weldability of the alloys was satisfactory and no problems such as porosity or hot tearing of the weld metal, or liquation cracking in the heat affected zone, were encountered. In all cases tensile tests on the weldments gave fractures in the parent plate. In accelerated creep tests, creep failure occurred by intergranular cracking, with creep rupture lives shorter than those of the comparable conventional steels.

2602 **(CONF-870883—1) The role of stellarators in the advanced toroidal program.** Sheffield, J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014815/JAW.

From Fusion power development: breakeven and beyond; Princeton, NJ, USA (27 Aug 1987).

The goals of this Program as discussed in the DOE-Magnetic Fusion Program Plan and in the Technical Program Activity, have two parts: development of a better understanding of the underlying physics of toroidal devices and the development of the stellarator as a candidate reactor, and as a source of building blocks for other toroidal reactors, such as the tokamak-stellarator hybrid. This paper briefly discusses these concepts. 3 refs.

2603 **(CONF-870901—4) Stability tests of the Westinghouse coil in the International Fusion Superconducting Magnet Test Facility.** Dresner, L.; Fehling, D.T.; Lubell, M.S.; Lue, J.W.; Luton, J.N.; McManamy, T.J.; Shen, S.S.; Wilson, C.T. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE88000598/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The Westinghouse coil is one of three forced-flow coils in the six-coil toroidal array of the International Fusion Superconducting Magnet Test Facility at Oak Ridge National Laboratory. It is wound with an 18-kA, Nb_3Sn/Cu, cable-in-conduit superconductor structurally supported by aluminum plates and cooled by 4-K, 15-atm supercritical helium. The coil is instrumented to permit measurement of helium temperature, pressure, and flow rate; structure temperature and strain; field; and normal zone voltage. A resistive heater has been installed to simulate nuclear heating, and inductive heaters have been installed to facilitate stability testing. The coil has been tested both individually and in the six-coil array. The tests covered charging to full design current and field, measuring the current-sharing threshold temperature using the resistive heaters, and measuring the stability margin using the pulsed inductive heaters. At least one section of the conductor exhibits a very broad resistive transition (resistive transition index = 4). The broad transition, though causing the appearance of voltage at relatively low temperatures, does not compromise the stability margin of the coil, which was greater than 1.1 J/cm^3 of strands. In another, nonresistive location, the stability margin was between 1.7 and 1.9 J/cm^3 of strands. The coil is completely stable in operation at 100% design current in both the single- and six-coil modes.

2604 **(CONF-871007—4) Ex-vessel remote maintenance design for the Compact Ignition Tokamak.** Spampinato, P.T.; Macdonald, D. (Oak Ridge National Lab., TN (USA). Fusion Engineering Design Center; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02. Order Number DE88000581/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The use of deuterium-tritium (D-T) fuel for operation of the Compact Ignition Tokamak (CIT) imposes a requirement for remote handling technology to carry out maintenance operations on auxiliary machine components. These operations consist of removing and repairing components such as diagnostics and radio frequency (rf) heating modules using remotely operated maintenance equipment. The major equipment that is being developed to accomplish maintenance external to the plasma chamber includes the bridge-mounted manipulator system for test cell operations, decontamination (decon) equipment, hot cell equipment, and solid radwaste handling equipment. Wherever possible, the project will use commercially available equipment. Several areas of the maintenance system design have been addressed in fiscal year (FY) 1987. These included conceptual designs of manipulator systems, the start of a remote equipment research and development (R and D) program, and definition of the hot cell, decon, and equipment repair facility requirements. The manipulator work included investigating transporters and viewing/lighting subsystems. In each case, existing commercial units are being assessed initially, along with viable alternative approaches. R and D work also included demonstrations of remote handling operations on full-size, partial mock-ups of the CIT machine at the Oak Ridge National Laboratory (ORNL) Remote Operations and Maintenance Development Facility.

2605 **(CONF-871007—5) Fabrication and installation of the vacuum vessel for the Advanced Toroidal Facility.** Chipley, K.K. (Pittsburgh-Des Moines Corp., Pittsburgh, PA (USA); Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02. Order Number DE88000593/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The vacuum vessel for the Advanced Toroidal Facility (ATF) has been completed and installed in the facility. The vessel fabrication has involved many unique methods to correct unanticipated problems. The primary fabrication concern has been to correct for dimensional inconsistency so that the vessel would fit into the closely nested helical coil set. The vessel has been installed and the remainder of the facility components are being assembled.

2606 **(CONF-871036—5) Corrosion of ferritic steels by molten lithium: Influence of competing thermal gradient mass transfer and surface product reactions.** Tortorelli, P.F. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000334/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

An Fe-12Cr-1MoVW steel was exposed to thermally convective lithium for 6962 h. Results showed that the weight change profile of Fe-12Cr-1MoVW steel changed substantially as the maximum loop temperature was raised from 500 to 600°C. Furthermore, for a particular loop experiment, changes in the structure and composition of the exposed surfaces did not reflect typical thermal gradient mass transfer effects for all elements: the surface concentration of chromium was often a maximum at intermediate temperatures, while nickel (present at low concentrations in the starting material) tended to be transported to the coldest part of the loop. Such data were interpreted in terms of a qualitative model in which there are different dominant reactions or the various constituents of the ferritic steels (surface product formation involving nitrogen and/or carbon and solubility-driven elemental transport). This competition among different reactions is important in evaluating overall corrosion behavior and the effects of temperature. The overall corrosion rate of the 12Cr-1MoVW steel was relatively low when compared to that for austenitic stainless steel exposed under similar conditions.

2607 **(CONF-871036—8) Design of spectrally tailored fusion reactor materials experiments in the HFIR [High Flux Isotope Reactor] RB [removable beryllium] capsule irradiation facility.** Longest, A.W.; Corum, J.E.; Heatherly, D.W.; Thoms, K.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000571/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

Design of four spectrally tailored capsules to irradiate magnetic fusion energy (MFE) materials specimens in the new High Flux Isotope Reactor (HFIR) removable beryllium (RB*) facility at temperatures of 60, 200, 330, and 400°C, respectively, is described. These designs incorporate provisions for removal, examination, and reencapsulation of the MFE specimens at intermediate exposure levels en route to a target exposure level of 30 displacements per atom (dpa). With the exception of the 60°C capsule, where the test specimens are in direct contact with the reactor cooling water, the specimen temperatures (monitored by 24 thermocouples) are con-

trolled by varying the thermal conductance of a small gap region between the specimen holder and the containment tube. Hafnium shields are used to tailor the neutron spectrum to closely match the helium production-to-atom displacement ratio (14 appm/dpa) expected in a fusion reactor first wall. These MFE capsule irradiations will begin in early 1988.

2608 **(CONF-871036—9) Irradiation creep in Type 316 stainless steel and US PCA with fusion reactor He/dpa levels.** Grossbeck, M.L.; Horak, J.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000565/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

Irradiation creep was investigated in type 316 stainless steel (316 SS) and US Fusion Program PCA using a tailored spectrum of the Oak Ridge Research Reactor in order to achieve a He/dpa value characteristic of a fusion reactor first wall. Pressurized tubes with stresses of 20 to 470 MPa were irradiated at temperatures of 330, 400, 500, and 600°C. It was found that irradiation creep was independent of temperature in this range and varied linearly with stress at low stresses, but the stress exponent increased to 1.3 and 1.8 for 316 SS and PCA, respectively, at higher stresses. Specimens of PCA irradiated in the ORR and having helium levels up to 200 appM experienced a 3 to 10 times higher creep rate than similar specimens irradiated in the FFTF and having helium levels below 20 appM. The higher creep rates are attributed to either a lower flux or the presence of helium. A mechanism involving interstitial helium-enhanced climb is proposed. 17 refs.

2609 **(CONF-871036—11) Temperature dependence of swelling in Type 316 stainless steel irradiated in HFIR [High Flux Isotope Reactor].** Hamada, S.; Maziasz, P.J.; Tanaka, M.P.; Suzuki, M.; Hishinuma, A. (Oak Ridge National Lab., TN (USA); Japan Atomic Energy Research Inst., Tokai, Ibaraki). 1987. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000387/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

The temperature dependence of swelling was investigated in solution-annealed (SA) and 20% cold-worked (CW) type 316 stainless steel irradiated to 30 dpa at 300 to 600°C in the High Flux Isotope Reactor (HFIR). At irradiation temperatures $\leq$ 400°C, a high concentration (2 to 4 x 10^{23} m^{-3}) of small bubbles (1.5 to 4.5 nm diam) formed uniformly in the matrix. Swelling was low (<0.2%) in both SA and CW materials irradiated to 30 dpa. In the SA 316, cavity size increased but the number density decreased with increasing irradiation temperature above 500°C. At 500°C, there was a mixture of bubbles and voids, but at 600°C, most of the cavities were voids. Maximum swelling (~5%) occurred at 500°C. By contrast, cavities in 20% CW specimens were much smaller, with diameters of 6 and 9 nm at 500 and 600°C, respectively, suggesting that they were primarily bubbles. The cavity number density in the CW 316 at both 500 and 600°C (~1 x 10^{22} m^{-3}) was about one order of magnitude less than at 400°C. Swelling increased slightly as irradiation temperature increased, peaking at 600°C (0.3%). These results indicate that SA 316 swells more than CW 316 at 500 and 600°C, but both SA and CW 316 are resistant to void swelling in HFIR at 400°C and below to 30 dpa. 15 refs.

2610 **(CONF-871125—1) A three-barrel repeating pneumatic pellet injector for plasma fueling of the Joint European Torus.** Combs, S.K.; Milora, S.L.; Baylor, L.R.; Foust, C.R.; Gethers, F.E.; Sparks, D.O. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000330/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

Pellet fueling, the injection of frozen hydrogen isotope pellets at high velocity, has been used to improve plasma performance in various tokamak experiments. In one recent experiment, the repeating pneumatic hydrogen pellet injector was used on the Tokamak Fusion Test Reactor (TFTR). This machine gun-like device, which was developed at the Oak Ridge National Laboratory (ORNL) with an objective of steady-state fueling applications, was characterized by a fixed pellet size and a maximum repetition rate of 4 to 6 Hz for several seconds. It was used to deliver deuterium pellets at speeds ranging from 1.0 to 1.5 km/s into TFTR plasma discharges. In the first experiments, injection of single, large (nominal 4-mm-diam) pellets provided high plasma densities in TFTR (1.8 x 10^{14} cm^{-3} on axis). After a conversion to smaller (nominal 2.7-mm-diam) pellets, the pellet injector was operated in the repeating mode to gradually increase the plasma density, injecting up to five pellets on a single machine pulse. This resulted in central plasma densities approaching 4 x 10^{14} cm^{-3} and n tau values of 1.4 x 10^{14} cm^{-3}s. For plasma fueling applications on the Joint European Torus (JET), a pellet injector fashioned after the prototype repeating pneumatic design has been developed. The versatile injector features three repeating guns in a common vacuum enclosure; the guns provide pellets that are 2.7, 4.0, and 6.0 mm in diameter and can operate independently at repetition rates of 5, 2.5, and 1 Hz, respectively. The injector has been installed on JET. A description of the equipment is presented, emphasizing the differences from the original repeating device. Performance characteristics of the three pneumatic guns are also included.

2611 **(CONF-8706180—3) Systems analysis of INTOR-like designs.** Flanagan, C.A. (Westinghouse Electric Corp., Oak Ridge, TN (USA)). Jun 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013544/JAW.

From INTOR review meeting; Atlanta, GA, USA (25 Jun 1987).

This paper contains viewgraphs on benchmarking a INTOR thermonuclear tokamak design. Parameter evaluations are made in comparison with other existing tokamaks as well as other reactor characteristics. (LSP)

2612 **(CONF-8706215—1-Vugraphs) Six months R & D review for WBS K.** Spampinato, P.T. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87012931/JAW.

From Engineering review board meeting; Princeton, NJ, USA (9 Jun 1987).

This report contains viewgraph information on fasteners, flanges, and connectors of general purpose manipulators of test cells at ORNL facility. (LEW)

2613 **(CONF-8709142—2-Vugraphs) Density limits and fueling: Prepared for data base assessment, 1985-1987.** Greenwald, M.; Sheffield, J. (Massachusetts Inst. of Tech., Cambridge (USA); Oak Ridge National Lab., TN (USA)). 21 Sep 1987. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000918/JAW.

From Ignition physics study group meeting; San Diego, CA, USA (21 Sep 1987).

This paper contains viewgraph material assessing the density limits and fueling limits of different thermonuclear devices. Various density limits are considered with emphasis on the Murakami limit and the Hugill limit. (GSP)

2614 **(IPPJ—769) Proceedings of topical meeting on particle beam fusion and its related problems, vol.1.** Niu, Keishiro (ed.). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1986. vp. (CONF-8510335—Vol.1). NTIS (US Sales Only), PC A12/MF A01. Order Number DE87780130/JAW.

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

Separate abstracts have been prepared for papers from this meeting on particle beam fusion.

2615 **(IPPJ—769(2)) Proceedings of topical meeting on particle beam fusion and its related problems, vol. 2.** Niu, Keishiro (ed.). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1986. vp. (CONF-8510335—Vol.2). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87780122/JAW.

From Meeting on particle beam fusion and its related problems; Nagoya, Japan (31 Oct 1985).

Separate abstracts have been prepared for papers from this meeting on particle beam fusion and related topics. The meeting was held in 1985 in Japan.

2616 **(IPPJ—792) Rotation of a magnetic field.** Aono, Osamu; Sugihara, Ryo. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Sep 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703592/JAW.

It is shown by reduction to absurdity that an axially symmetric magnetic field around a cylindrical magnet can not rotate, even if the magnet rotates upon its axis of symmetry.

2617 (IPPJ—818, pp 143-160) **Particle simulation of divertor plasma.** Takizuka, Tomonori; Tani, Keiji; Azumi, Masafumi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1987. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88780008/JAW. (CONF-8509216—).

From US-Japan workshop on advanced plasma modeling; Nagoya, Japan (24 Sep 1985).

Characteristics of divertor plasma are studied by using a one-dimensional electrostatic particle code with a binary collision model. Effects of recycling particles near the divertor plate are introduced. Heat flow is investigated in detail, and the estimation of ion heat conduction from the temperature gradient is found unaccurate when particles are highly recycled near the plate.

2618 **(IPPJ-AM—50) Proceedings of the Japan-US Workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices.** Miyahara, Akira; Wilson, K.L. (eds.). (Nagoya Univ. (Japan). Inst. of Plasma Physics; Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1987. 515p. (CONF-870185—). NTIS, PC A22/MF A01; 1; GPO Dep. Order Number DE87013568/JAW.

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The Japan-US workshop on "Plasma Material Interaction/ High Heat Flux Data Needs for the Next Step Ignition and Steady State Devices," was held at Institute of Plasma Physics, Nagoya University, on January 26-30, 1987. The primary objective of this workshop was to answer the question, "Are existing carbon materials (graphites and carbon-carbon composites) feasible for the CIT-experiment or not." The approach to this question needs a definition of how reference materials for CIT are to be selected out of existing materials. Most papers in this report deals with this question by testing different types of graphite as first wall material for thermonuclear devices. 42 individual reports were cataloged separately.

2619 (IPPJ-AM—50, pp 100-110) **Some considerations on plasma facing materials in Tokamak Fusion devices.** Murakami, Y. (Japan Atomic Energy Research Institute). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

In order to assess the materials problems for the next step ignition and steady state fusion devices, the author discusses the critical issues of plasma facing materials, the comparison between low-Z materials and high-Z materials, and the future prospects of plasma facing materials development.

2620 (IPPJ-AM—50, pp 111-131) **Experience with graphite in JET.** Dietz, K.J. May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

A summary of in vessel components employing graphite as the materials facing the plasma is given. This relates in particular to inner wall protection, belt limiter and separatrix dump plates. The experience gained with graphite components shows on the one hand that graphite does not show damage as long as it is operated within the design limits and on the other hand exhibits high fluence against overloading conditions.

2621 (IPPJ-AM—50, pp 132-148) **US efforts on graphite and carbon related material studies.** Wilson, K.L. (Sandia National Labs., Livermore, CA). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The US Plasma-Material interaction and high heat flux programs on graphite and carbon-based materials is reviewed. Highlights of research at Sandia, Oak Ridge, and UCLA are included.

2622 (IPPJ-AM—50, pp 149-155) **Japanese efforts on characterization of isotropic graphite materials for fusion reactor.** Yamashina, Toshiro. (Hokkaido Univ., Sapporo, Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Current activities of Japanese university linkage for characterization of isotropic graphite materials were introduced briefly. In this research project, 15 graphite materials from 7 Japanese companies have been selected as common testing materials. Now, characterization of those graphite materials is being made by 15 different institutes, in terms of their structure and physical properties from the viewpoint of plasma-wall-interactions.

2623 (IPPJ-AM—50, pp 156-165) **Carbon erosion processes for CIT and ETR applications.** Haasz, A.A. (Univ. of Toronto, Ontario). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Graphite has been identified as a primary candidate material for next generation Tokamak (e.g., CIT, ETR). Under plasma exposure, graphite erosion occurs through physical sputtering, chemical erosion and radiation-enhanced sublimation. The temperature regimes where these processes dominate the erosion have been identified, and the dependence of erosion yield on graphite temperature and incident plasma particle (H^+, H^0, H/sub e/$^+$) energies and fluxes have been discussed. The effects of surface and bulk impurities in graphite, as well as oxygen impurity in the plasma, on the erosion rate have been considered.

2624 (IPPJ-AM—50, pp 166-181) **Semi-empirical equations for modelling of chemical erosion of graphite.** Itoh, Noriaki. (Nagoya Univ., Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

A semi-empirical equation for modelling chemical erosion of graphite by energetic hydrogen ions has been developed. Equations were found to explain semi-quantitatively several important features, energy dependence, flux dependence and synergistic effects under simultaneous multi-particle irradiation.

2625 (IPPJ-AM—50, pp 182-190) **Comment on plasma facing material studies for ETR.** Miyahara, Akira. (Nagoya Univ., Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

ETR family has been defined as the next generation machine after present day's devices like JT-60, TFTR, JET and the next step machine like CIT and TORE SUPRA, ASDEX-U, LSH. The requirements to plasma facing materials for ETR are discussed and summarized.

2626 (IPPJ-AM—50, pp 190-197) **Tiber II/ETR.** Henning, C.D. May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

This paper investigates possible parameters for a Tiber II/ETR Tokamak Design. Comparisons of different designs are discussed. (LSP)

2627 (IPPJ-AM—50, pp 198-210) **Application of graphite materials to the next generation machine.** Seki, Masahiro. (Japan Atomic Energy Research Institute). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Performance of graphite tiles to protect the first wall against plasma disruption is discussed. Two dimensional elastic analysis of the first wall with a bonded graphite tile shows that the stress in the graphite exceeds the Su of IG-11 equivalent graphite to a depth of 0.4 mm.

2628 (IPPJ-AM—50, pp 213-228) **Some brief remarks on several critical aspects of graphite data bases for fusion energy applications.** Eatherly, W.P. (Oak Ridge National Lab., TN). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The theory of graphite thermal conductivity is briefly reviewed and the data requirements and manufacturers' limitation are summarized. The existence of multiple flaw field in graphite and their role in failure strength and its statistics is traced. The use of fracture mechanics concepts is key and leads to non-destructive (sonic) techniques to predict actual failure strength.

2629 (IPPJ-AM—50, pp 229-237) **Characterization of graphites and C-C-composites.** Oku, Tatsuo. (Japan Atomic Energy Research Institute). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Physical and chemical properties are important to foresee the behavior of graphite tiles under fusion plasma environment. Data base of this aspect has been overviewed.

2630 (IPPJ-AM—50, pp 238-250) **Sandia Livermore conditioning studies.** Wilson, K.L. (Sandia National Labs., Livermore, CA). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The Sandia Livermore outgassing database for graphite and carbon-carbon composites is summarized, and testing of a 4-D carbon-carbon composite in TEXTOR is reported.

2631 (IPPJ-AM—50, pp 251-258) **Thermal outgassing of various kinds of graphite.** Kubota, Yusuke. (Nagoya Univ., Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Thermal outgassing of various kinds of graphites has been measured by using a TDS device and valence for fusion application. The TDS device and a set of results for the effect of kind, pretreatment, and surface area of graphite on the outgassing were reported.

2632 (IPPJ-AM—50, pp 260-267) **On gas uptake of coated and bare graphite during exposure to air.** Vernickel, H.; Bohdansky, J.; Kutsch, H.J.; Ottenberger, W.; Roth, J.; Scherzer, R.; Steinberger, F.; Trcka, E. May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The gas release of carbon probes from different manufacture and the gas-uptake during air exposure was investigated. Sealing of graphite with pyrocarbon (CVD) does not reduce the short-time gas-uptake in 1 to 2 days, but slows down the farther gas-uptake in one case but not in another one. Also the mass-spectroscopic investigation of desorbed species shows large differences in the composition and in the desorption temperature at equal weight loss.

2633 (IPPJ-AM—50, pp 268-272) **Hydrogen and deuterium retention in wall samples of JET.** Behrisch, R.; Borgesen, P.; Ehrenberg, J.; Wielunski, M.; Martinelli, A.P.; Bergsaker, H.; Emmoth, B.; Coad, J.P. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen, Germany; Research Institute of Physics, Stockholm, Sweden; JET Joint Undertaking, Abingdon, England). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The amount of H and D trapped in vessel walls of carbon-containing tokamaks is of the order of 2×10^{17} to 10^{18}(D + H)/cm^2 determined from long time samples in JET ($\sim 10^3$ discharges). The hydrogen is probably trapped by codeposition of H and D with carbon. The total amount of H and D in their layers corresponds to about 100 times the amount of H and D in the plasma.

2634 (IPPJ-AM—50, pp 273-275) **Absorption and desorption of D_2 on graphite.** Atsumi, H.; Miyake, M. (Osaka Univ., Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Thermal desorption measurements have been performed on the graphite exposed to deuterium gas atmosphere at 200 to 900°C under a given pressure within 0.05 to 1 atm for 0.1 to 20h. The typical results of this study are summarized.

2635 (IPPJ-AM—50, pp 276-284) **High heat flux tests on C-materials.** Linke, J. (Kernforschungsanlage Juelich G.m.b.H., West Germany). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

High heat flux simulation test were performed in electron beam devices (SNLA, KFA) mainly on laboratory scale samples (different grades of graphite, C-C-composites pyrocarbon); besides this actively cooled components also were tested. Main aspects of these experiments were: erosion behavior; thermal shock resistance; thermal cycling behavior; investigation of particle emission.

2636 (IPPJ-AM—50, pp 286-301) **Disruption simulation experiments on graphite by H^+-beam at the 10MW neutral beam injection test stand of the IPP Nagoya.** Bolt, H.; Croessmann, C.D.; Miyahara, Akira; Kuroda, T.; Oka, Y.; Sakurai, K. (Nuclear Research Center, Juelich, West Germany, Sandia National Labs., Albuquerque, NM; Nagoya Univ., Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The behavior of eleven different graphite grades (US-Japanese and European graphites) under disruption conditions was evaluated. Large size samples (50mm x 50mm surface) were exposed to ion beam pulses of power densities of 90...1000MW/m^3 and pulse length of about 200ms. High strength graphites tended to crack under the heat fluxes whereas isotropic fine grain graphites behaved well.

2637 (IPPJ-AM—50, pp 302-307) **Runaway-electron simulation by electron linear accelerator experiments.** Bolt, H.; Miyahara, Akira; Miyake, M.; Yamamoto, T. (Kernforschungsanlage Juelich, G.m.b.H., West Germany; Nagoya Univ., Japan; Osaka Univ., Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Electron beam of energies of 20 to 30MeV produced by an electron linear accelerator has been used to simulate runaway electron events. Bulk graphite showed a superior behavior to MeV-electron bombardment than stainless steel. In activity cooled structures the metal cooling tubes may undergo serious thermal excursions to their failure.

2638 (IPPJ-AM—50, pp 308-315) **Thermal shock and fracture toughness considerations for graphite in Tokamak reactors.** McGrath, R.T.; Stephens, J.J. (Sandia National Labs., Albuquerque, NM). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

This paper is mainly a collection of viewgraphs containing: a survey of thermal shock parameter for existing graphites, and fracture toughness testing of graphites. Graphites which rank highest in thermal shock parameter do not rank highest in fracture toughness.

2639 (IPPJ-AM—50, pp 316-325) **High flux plasma bombardment of graphite.** Hirooka, Yoshihiko. (California Univ., Los Angeles). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Recent experimental results of high flux ($\sim 10^{18}$ ions/sec/cm^2) hydrogen plasma bombardment experiments in PISCES, particularly on graphite, are reviewed. Under a typical redeposition condition, the erosion yield is reduced by a factor of 2 $\sim$ 3. Various graphite materials including ATJ, POCO, Pyro-graphite and 3D C-C weave are compared with respect to the erosion yield. The C-C weave is found to be the best material so far. Also the first experimental result of controlled graphite pumping experiments is presented. High fluence helium plasma (10^{21-23} ions/cm^2) activates the graphite surface for pumping neutrals. The activated graphite surface showed retarded hydrogen re-emission characteristic which might be one of the key factors for TFTR's supershot.

2640 (IPPJ-AM—50, pp 326-327) **Assessment of graphite for limiter/divertor and first wall tiles in CIT and ETR-type machines.** Haasz, A.A. (Univ. of Toronto, Ontario). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The expected range of operating graphite temperature and plasma parameters for CIT and ETR-type machines were identified. The available database for graphite erosion was evaluated with respect to first wall and limiter/divertor requirements. Physical sputtering, chemical erosion, radiation/enhanced sublimation and synergistic erosion were discussed. The effects of surface impurities, bulk impurities, plasma impurities, redeposition/codeposition and use of carbon/carbon composites were also addressed.

2641 (IPPJ-AM—50, pp 328-332) **Ion-induced sputtering and interfacial reaction of metals or metal carbides deposited on graphite at temperatures.** Morita, Kenji. (Nagoya Univ., Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

It has been shown, concerning suppression of chemical sputtering, that sputtering of metal atoms from metal layer (Ni) or metal carbide layer (TiC, Cr_7C_3) deposited on graphite is substantially suppressed, below certain critical ion flux, by coverage of the surface with segregated carbon atoms, which are continuously supplied via diffusion from graphite substrate.

2642 (IPPJ-AM—50, pp 333-341) **Chemical erosion of graphite and diamond materials due to low energy hydrogen bombardment.** Yamada, Reiji. (Japan Atomic Energy Research Institute). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Chemical erosion of graphite due to hydrogen ion bombardment in the regime of low energy ($\simeq$several keV) and low flux ($\simeq 10^{16}$/cm^3 sec) bombardment measured by JAERI was compared with the data of Toronto group and Garching group. The difference between these groups is rather small and consistent. Diamond compacts and film produced by CVD method at 900°C for the substrate temperature shows low chemical erosion compared with graphite.

2643 (IPPJ-AM—50, pp 342-346) **Comment on erosion of graphite.** Philippe, V. (Kernforschungsanlage Juelich G.m.b.H., West Germany). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Radiation enhanced sublimation - the interstitial model to explain the radiation enhanced sublimation has been further proved. It predicts a threshold down to small energies similar as for the production of Frenhel pairs. A flux dependence is predicted, so that the yield cell decreases proportional to $(P)^{3/4}$ (P: Frenhel pair production rate). Chemical erosion of hydrocarbon films; which the chemical erosion of pure graphite differs significantly when using either thermal atomic hydrogen or energetic ions (yield increases from 5 x 10^{-4} to $\sim$5 x 10^{-2} C/H), a-C:H films are highly reactive against atoms alone. The erosion yield of a-C:H films when bombarded with thermal atoms is in the maximum 800k of the order 0/10^{-1} and so similar as that of energetic ions on these films which is quite similar to the yield of pure graphite. It has been further found that hydrogen saturated graphite layers show also a high reactivity against atoms alone.

2644 (IPPJ-AM—50, pp 347-349) **Thermal desorption process and surface roughness of POCO graphite irradiated by hydrogen ion beam.** Hino, Tomoaki. (Hokkaido Univ., Sapporo, Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

POCO Graphite samples were irradiated by H_3^+ ion beam (9keV), and the thermal desorptions of H_3 and CH_4 were studied by thermal desorption spectroscopy. The peak temperature, which gives a maximum of H_3 desorption, increased at lower irradiation number but decreased at higher irradiation number. For CH_4, the peak temperature was roughly constant for the irradiation number. The surface roughness factor of the graphite decreased as the irradiation number.

2645 (IPPJ-AM—50, pp 350-360) **Estimation of retention, permeation and recycling.** Tanabe, Tetsuo. (Osaka Univ., Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

For estimation of hydrogen recycling properties, the importance of effect of gaseous hydrogen background is emphasized based on the recent data showing the rather high solubility of hydrogen in graphite. The importance of time transient behavior is also mentioned.

2646 (IPPJ-AM—50, pp 361-383) **Tritium inventory.** Wilson, K.L. (Sandia National Labs., Livermore, CA). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Tritium inventory estimates for TFTR and CIT are summarized. Modeling is too imprecise to provide accurate calculations. Instead, tritium inventory is estimated using an empirical approach.

2647 (IPPJ-AM—50, pp 384-401) **Trapping-release behaviours of hydrogen isotopes in/from graphite: Modification by the presence of Fe impurity.** Ichimura, Kenji; Ashida, K.; Matsuyama, M.; Watanabe, K. (Toyama Univ., Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

In trapping-release of hydrogen isotopes in/from graphite trapping states and thermal release mechanisms were determined, and recombination factor and inventory were evaluated. Graphite characteristics were modified by ion bombardments (D_3^+ and H/sub e/$^+$) and by presence of Fe impurity. The surface recombination factor of the iron-coated graphite was smaller than that of pure graphite below 600°C.

2648 (IPPJ-AM—50, pp 402-407) **Hydrogen permeation through graphite.** Yamawaki, Michio. (Univ. of Tokyo, Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Graphite is porous material so that gaseous diffusion through pores and atomic diffusion on pores are intrinsically important in evaluating the hydrogen retention and permeation rate of graphite. Linear pressure dependence of permeability was found in the down to $\sim 10^{-2}$ Pa region suggesting the viscous flow limiting kinetics. Extremely large temperature dependence of permeability was observed, but could not be adequately explained by the existing models. Extensive studies are needed to understand this aspect of hydrogen behavior in graphite.

2649 (IPPJ-AM—50, pp 408-410) **Comments on recycling and hydrogen inventory.** Philipps, V. (Kernforschungsanlage Juelich G.m.b.H., West Germany). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Recycling behavior in tokamaks with metals walls can be understood based on material parameters of diffusion constants, recombination rates, solubilities, etc. of hydrogen in metals. The expected recycling in fusion devices with carbon walls is believed to be determined by the saturation of graphite due to hydrogen impact. This would result in $R = 1$ after a transient pumping with $R < 1$ and further change in the recycling would be only caused by temperature excursions of the walls. In contrast, present observations in tokamaks (JET, TFTR, TEXTOR) can not be explained by this simple picture. The final clarification of the observed phenomena is still open. The answer to this behavior will also drastically influence the expected tritium inventory in fusion machines.

2650 (IPPJ-AM—50, pp 411-423) **Some considerations on selection criteria for graphites as fusion materials.** Oku, T. (Japan Atomic Energy Research Institute). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Some considerations are made on the selection criteria for graphite materials when they are used for the fusion reactor components. The selection criteria are examined considering that the graphite might fracture due to internal stresses. The internal stresses consist of a thermal stress based on temperature gradient in the components and irradiation-induced stress associated with dimensional changes due to neutron irradiation. It is stressed that the irradiation-induced stress is particularly important. There it may be impossible for the graphite to fracture if a stress generated is smaller than the fracture stress and a stress intensity factor or a J-integral value which controls initiation and extension of cracks is smaller than the respective fracture toughness value. From such viewpoints the selection criteria for graphite materials are examined and the present status of the data base on properties which are considered to be significant is reviewed. As a result, the data group which should be intensively obtained are defined.

2651 (IPPJ-AM—50, pp 424-432) **Presentations on graphite technology.** Eatherly, W.P. (Oak Ridge National Lab., TN). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The properties Kic, E, and ultimate tensile strength have been measured on three graphite irradiated to neutron fluences beyond dimensional turn-around. Kic is relatively unaffected, while the effective flaw size monotonically decreases. Gic as calculated from Kic monotonically decreases consistent with the model of original flaw heating accompanied by generation of many new small flaws.

2652 (IPPJ-AM—50, pp 433-434) **Neutron irradiation tests for graphite and low-Z-ceramics.** Linke, J. May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

A short report is given on the irradiation tests which are planned or have already started in the frame of the KFA programme. These include neutron irradiation tests on graphites and low-Z ceramics in a fission neutron environment(HFR-Petten) and in a spallation neutron flux(LAMPF-Los Alamos), respectively.

2653 (IPPJ-AM—50, pp 435-440) **Runaway electron analysis for TORE SUPRA.** McGrath, R.T. (Sandia National Labs.). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The localized energy deposition of runaway electrons can have discontinuous effects for tokamak interior components, especially there operating with active cooling. Experience on JET implies that as much as 40kJ can be deposited over small surface areas, $\sim 5 cm^2$, per runaway event. Presented here is the analysis of electron slowing down in graphite armor and coolant lines for the actively cooled limiters to be used on TORE SUPRA. We find that significant energy is deposited outside the projected beam aria due to large angle scattering events and that 2.0 cm or more of graphite armor is required to reduce localized heating of the coolant lines to a manageable level.

2654 (IPPJ-AM—50, pp 441-443) **Fusion application of C-C composites.** Uchikawa, Takashi. (Mitsubishi Heavy Industries, Ltd.). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

C-C composites have high potentialities for fusion applications, although limitation on fabricability and long time needed for production, etc., are engineering subjects at present. As one step to realize a large C-C composite fusion component, advanced ALT-II limiter blades of C-C composite are now being developed. C-C composites should be characterized considering the factors, such as fiber properties, composite production methods, weave configuration, treatment conditions, etc.

2655 (IPPJ-AM—50, pp 444-451) **Problems with criteria for material selection and failure assessment.** Shibui, Masanao. (Toshiba Corp.). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Criteria for material selection and failure assessment have been discussed and reviewed with particular emphasis on the localized erosion due to intense pulsed energy deposition and failure mode of graphite under biaxial stress state.

2656 (IPPJ-AM—50, pp 452-467) **Active cooling with swirl tube enhancement with application to the Tore Supra modular limiter design.** McGrath, R.T. (Sandia National Labs.). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Tokamaks operating with pulse length greater than 10 seconds will require active cooling of plasma contacting surfaces. For limiter leading edges heat fluxes as high as 3-5kW/cm^2 are to expected. Testing at the electron beam test facility at Sandia shows that these limits can be achieved using high flow velocity, subcooled water with enhancement of the heat transfer with twisted tapes. In addition, surface temperatures of graphite armor tiles can be kept below 1200°C using pyrolytic graphite.

2657 (IPPJ-AM—50, pp 468-474) **CO_2 laser beam test of an actively cooled first-wall element with a graphite-clad SiC armor tile.** Gotoh, Yoshitake; Okamura, Hisanori; Itoh, Shinnichi. (Hitachi Research Lab., Ibaraki, Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

A graphite-clad SiC tile of 29mm dia and 15mm thickness is bonded to a base metal (Cu or 316 SS) with insertion of Cu-35 vol%C composite sheet. The elements are tested under active cooling condition by using 3.5kW CO_2 laser beam at heat flux condition of 0.3 ~ 1.7kW/cm^2 and a pulse length of 40s.

2658 (IPPJ-AM—50, pp 475-497) **Limiter heat loads in TFTR due to disruptions.** Ulrickson, M. (Princeton Univ., NJ). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

A fast infrared thermometer was constructed to measure the temperature of the TFTR Bumper Limiter during disruptions with 10μsec time resolution. The results indicate peak surface temperatures of 1800C at 10MJ of NB heating. The rise time of the temperature is as short as 20μsec. The heat flux is found to be up to 40kW/cm^2. The energy deposition is up to 200J/cm^2. Extrapolation to CIT is made.

2659 (IPPJ-AM—50, pp 498-500) **Design aspects of in-vessel components.** Dietz, K.J. May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The process leading from the design idea to the procurement of in-vessel components is shown; starting from the physics input the iterative process of the design is demonstrated in form of functional blocs.

2660 (IPPJ-AM—50, pp 501-506) **Experiment on first wall carbon coating-focusing hydrogen concentration.** Sakamoto, Yuichi. May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

A simulation experiment on the first wall carbon coating has been carried out by the use of RIKEN ECR-2 device. Main results are as follows, obtained one hard, high density and amorphous carbon films on SUS 304 samples by ECR discharge in CH_4/H_2(1/1) mixture gas, high energy ion bombardment seems to be effective to decrease in H/C value, clean up of harmful carbon films deposited on observation windows and so on, can be done by a local pure hydrogen plasma.

2661 (IPPJ-AM—50, pp 507-513) **Properties of carbon coating films produced by glow, RF and ECR discharges.** Hino, Tomoaki. (Hokkaido Univ., Sapporo, Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

Carbonization experiments have been successfully performed in Heliotron E, JIPP-IIU, TEXTOR and ECR-II(RIKEN). We have investigated the properties of C-films produced in above devices; film thickness, depth composition profile, hydrogen content, chemical binding state and crystal structure. The film deposition rates are ~10A/min in glow discharge and ~50A in ECR discharge. The dense/hard carbon film can be obtained by ECR plasmas. The hydrogen content of C-films due to ECR plasmas is lower. In Heliotron E, the erosion rate of the carbon film due to hydrogen plasmas is estimated as 20A/hr, which is much smaller than the film deposition rate. In addition, the TiC ceramics is formed at the wall both with carbonization and Ti-flashing.

2662 (IPPJ-AM—50, pp 394-400) **Summaries of interactions between tritium and graphite.** Ichimura, K.; Ashida, K.; Matsuyama, M.; Watanabe, K. (Toyama Univ., Japan). May 1987. NTIS, PC A22/MF A01. Order Number DE87013568/JAW. (CONF-870185—).

From Japan/US workshop P-92 on plasma material interaction/high heat flux data needs for the next step ignition and steady state devices; Nagoya, Japan (26 Jan 1987).

The trapping release behavior of hydrogen isotopes from graphite is characterized by trapping states, thermal release, a recombination factor, and retention. The irradiation effects are examined by an ion bombardment (hydrogen isotopes and helium). (WRF)

2663 (JAERI-M—86-149) **Design study of plant system for the fusion experimental reactor (FER).** Iida, Hiromasa; Kuroda, Hideo; Yamada, Masao; Suzuki, Tatsushi; Honda, Tsutomu; Ohmura, Hiroshi; Itoh, Shinichi. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 324p. (In Japanese). NTIS (US Sales Only), PC A14/MF A01. Order Number DE87703601/JAW.

This report describes design study results of the FER plant system. The purpose of this study is to have an image of the FER plant system as a whole by designing major auxiliary systems, reactor building and maintenance and radwaste desposal systems. The major auxiliary systems include tritium, cooling, evacuation and

fueling systems. For these each systems, flowdiagrams are studied and designs of devices and pipings are conducted. In the reactor building design, layout of the above auxiliary systems in the building is studied with careful zoning concept by the radiation level. Structural integrity of the reactor building is also studied including seismic analysis. In the design of the maintenance and radwaste system flowdiagram of failed reactor components is developed and transfer vehicles and buildings are designed. Finally assuming JAERI Naka site as the reactor site layout of the whole FER plant system is developed.

2864 **(JAERI-M—87-061) Initial results of lower hybrid current drive experiment on JT-60.** Sakamoto, Keishi; Imai, Tsuyoshi; Ikeda, Yoshitaka. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750054/JAW.

The initial results of current drive experiment by lower hybrid range of frequencies (LHRF) on JT-60 are reported. This experiment is a first trial of RF current drive on a reactor grade tokamak. As the result, the current of 1.7 MA is driven by LHRF with the power of 1.2 MW (2.0 GHz) at the density n-bar/sub e/ = 0.3 x 10/sup 19/ m/sup -3/. The efficiency of current drive eta/ sub CD/(ident to n-bar/sub e/(10/sup 19/ m/sup -3/)I/sub RF/ (MA)R(m)/P/sub RF/(MW)) is 0.7 — 1.7. When neutral beams are combined with LHRF, eta/sub CD/ increased to 2.0 — 2.8. Furthermore, current ramp up and recharging were carried out. The efficiencies of current ramp up and recharging are approximately 0.2 for both. Also, the suppression of soft X-ray sawtooth signals is recognized, as obserbed on middle sized tokamak.

2865 **(JAERI-M—87-064) Simple model for hot ion plasmas.** Thomas, P.R. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750045/JAW.

This note describes a zero dimensional model for the power balance in the center of tokamaks with additional heating. The main features of the model are classical equipartition and characteristic times, based on L-mode scaling, to represent conductive and convective losses. The model has been tested against data from JET, JT-60 and TFTR. Satisfactory results are obtained if it is assumed that the ions are 3 - 5 times better confined than the electrons. The good performance of the TFTR "supershots" is found to be associated with the very high power density near to the magnetic axis which is characteristic of these discharges. JET and JT-60, having much lower power densities with NBI alone, can only match the TFTR ion temperatures at lower densities. The performance of JT-60 is predicted to improve markedly if deuterium is used instead of hydrogen.

2866 **(JAERI-M—87-070) Development of the in-vessel inspection system on JT-60.** Yoshiyuki, Takeshi; Takatsu, Hideyuki; Arai, Takashi; Sunaoshi, Hidenori; Kaminaga, Atsushi; Ohkubo, Minoru; Nakajima, Kikuo; Syoji, Makoto. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 48p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750047/JAW.

JT-60 in-vessel inspection system was developed to observe the interior of the JT-60 vacuum vessel during intervals of plasma shots without break of the high vacuum. The objective of this system is the detection of the damages of the first walls attached on the inner surface of the vacuum vessel. High resolution pictures are provided by a periscope, which relays images of the vessel interior with a mirror and a set of lenses. Images provided by the periscope can be observed not only by eyepieces but also a TV camera and a still camera. The pictures of the TV camera are transmitted to the JT-60 control room and can be observed through a monitor television. This system can be operated by local consoles as well as remote consoles of the control room. Automatic operation is also possible from the control room. This system was completed December, 1986, and has been in operation since January, 1987, with satisfactory results.

2867 **(JAERI-M—87-075) JT-60 divertor pumping system and its pumping characteristics in divertor discharges.** Ando, Toshio; Nakamura, Hiroo; Sunaoshi, Hidenori; Arai, Takashi; Akino, Noboru; Hiroki, Seiji; Yamamoto, Masahiro. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750298/JAW.

The JT-60 divertor pumping system and its pumping characteristics in divertor discharges are described. The objective of this system is an active particle control in long pulse and high power neutral beam heated divertor discharges. The pumps are composed of compact non-evaporable Zr-Al getter pumps with a total pumping speed of 5.6 m/sup 3//s for hydrogen in the divertor chamber. It is found from the pumping experiment in joule heated and neutral beam heated divertor discharges that the pressure in the divertor chamber increases approximately in proportion to the square of the line averaged electron density n-bar/sub e/ of the main plasma. A total particle exhaust rate of 3 Pam/sup 3//s is possible for n-bar/sub e/ = 6 x 10/sup 19/ m/sup -3/ which is as large as the fueling rate by the neutral beam injection with a heating power of 20 MW. The density decay characteristics of the main plasma in the discharges with getter pumps-on and no pumping show an evident particle control effect by this pumping system.

2868 **(JAERI-M—87-078) Observation of enhanced neutral influx around the antenna during ICRF heating in JFT-2M tokamak.** Tamai, Hiroshi; Ogawa, Toshihide; Matsumoto, Hiroshi; Odajima, Kazuo. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750056/JAW.

Intensity of H/sub α/ line emission which is indicated the amount of neutral influx is observed during ion cyclotron range of frequencies (ICRF) heating in JFT-2M Tokamak. H/sub α/ emission increases faster and larger in the vicinity of ICRF antenna than in the remote place. The increment of H/sub α/ emission at the antenna during ICRF heating is proportional to the increment of electron density. It is concluded that the neutral influx supplied around the antenna contributes to the electron density build-up during ICRF heating.

2869 **(JAERI-M—87-079) Studies on structural analysis related to the design of the JT-60 vacuum vessel.** Takatsu, Hideyuki. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 187p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750299/JAW.

Studies on structural analysis of a vacuum vessel of tokamak-type fusion devices are presented. The present studies are proposals for the structural analysis procedures of the tokamak-type fusion devices and are composed of five parts, each of which covers the fundamental area required for the structural analysis and design; stress analysis, dynamic response analysis, fatigue evaluation, buckling analysis and seismic analysis. Special attention is paid to the critical component, bellows and the critical load, electromagnetic forces. A new finite element method modeling technique is proposed for the stress analysis of U-shaped bellows, where the bellows is replaced by an orthotropic plate having the same stiffness as the bellows. The applicability of the present modeling technique is confirmed by verification tests. Dynamic response and fatigue of the vacuum vessel are critical issues of the structural analysis and design of the tokamak-type fusion devices. Detailed dynamic response analyses of the JT-60 vacuum vessel are presented paying special attention to the dynamic behavior of the U-shaped bellows, where the above-mentioned modeling technique of the U-shaped bellows is applied. A fatigue evaluation method of the vacuum vessel under the dynamic electromagnetic forces is proposed, which utilizes the results of the detailed dynamic response analysis. In the present method, fatigue evaluation method for random loads is applied. Torsional fatigue strength of the welded bellows is experimentally evaluated aiming the application to the port of the fusion device and it is shown that the welded bellows reveals elastic buckling and spiral distortion under a small angle of tortion. Two formulae are proposed to evaluate the stress of the welded bellows under the forced angle of tortion.

2670 **(JAERI-M—87-083) Shielding design of fusion experimental reactor (FER). Calculation methods and shielding properties.** Mori, Seiji; Seki, Yasushi; Mohri, Kensuke. (Japan Atomic Energy Research Inst., Tokyo). Jun 1987. 79p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750292/JAW.

This report first describes the basic design philosophy of radiation shields for the fusion experimental reactor (FER) which has been proposed to be the next step machine to JT-60. Next, geometrical models and calculation parameters for shielding calculations were investigated to establish the standard design calculation methods, and accuracy of the calculation was evaluated. Further, irradiation properties of in-vessel components and bulk shielding properties were summarized in the useful form for the future design works.

2671 **(JAERI-M—87-086) Enhancement of wall fueling and improvement of n-tau of an H-mode discharge by electron cyclotron wave in the JFT-2M tokamak.** Sengoku, Seio; Funahashi, Akimasa; Hasegawa, Mitsuru. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750312/JAW.

The additional increases both in the density n and confinement time tau of the beam heated H-mode discharges are observed (ntau value is improved more than 40%) when an electron cyclotron wave (ECW) resonating near the plasma boundary is applied. The ECW is shown to enhance wall fueling, to decrease the minimum heating power for switching the H-mode or to extend the operational regime on n-tau diagram of the H-mode discharges.

2672 **(JAERI-M—87-093) Main physics features driving design concept and physics design constraints. Conceptual design study of FY86 FER.** Fujisawa, Noboru; Sugihara, Masayoshi; Yamamoto, Shin. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 67p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750309/JAW.

Major physics design philosophies are described, which are essential bases for a plasma design and may have significant impacts on a reactor design concept. Those design philosophies are classified into two groups, physics design drivers and physics design constraints. The design drivers are featured by the fact that a designer is free to choose and the choice may be guided by his opinion, such as ignition, a pulse length, an operation scenario, etc. The design constraints may follow a physical law, such as plasma confinement, β-limit, density limit, and so on.

2673 **(JAERI-M—87-096) Observation of H-mode by electron cyclotron heating of JFT-2M tokamak preheated by a neutral beam.** Hoshino, Katsumichi; Yamamoto, Takumi; Suzuki, Norio. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750313/JAW.

H-mode is observed by the electron cyclotron heating(ECH) of JFT-2M tokamak preheated by a neutral beam(NB). The effect of the ECH to the realization of the H-mode varies as the position of the electron cyclotron resonance(ECR) layer. The effect of ECH is prominent when the ECR layer locates just inside of the separatrix. This shows that the edge electron heating is effective for the attainment of the H-mode. And the effect of ECH is comparable to or better than that of the NB heating.

2674 **(JAERI-M—87-098) JT-60 database system. 2. Detailed design manual.** Itoh, Yasuhiro; Kurihara, Kenichi; Kimura, Toyoaki. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 101p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750315/JAW.

The JT-60 central control system, "ZENKEI" collects the control and instrumentation data relevant to discharge and device status data for plant monitoring. The former of the engineering data amounts to about 3 Mbytes per shot of discharge. The "ZENKEI" control system which consists of seven minicomputers for on-line real-time control has little performance of handling such a large amount of data for physical and engineering analysis. In order to solve this problem, it was planned to establish the experimental database on the Front-end Processor (FEP) of general purpose large computer in JAERI Computer Center. The database management system (DBMS), therefore, has been developed for creating the database during the shot interval. The engineering data are shipped up from "ZENKEI" to FEP through the dedicated communication line after the shot. The hierarchical data model has been adopted in this database, which consists of the data files with tree structure of three keys of system, discharge type and shot number. The JT-60 DBMS provides the data handling packages of subroutines for interfacing the database with user's application programs. The subroutine packages for supporting graphic processing and the function of access control for security of the database are also prepared in this DBMS.

2675 **(LA-UR—87-2985) Refueling and density control in the ZT-40M reversed field pinch.** Wurden, G.A.; Weber, P.G.; Watt, R.G.; Munson, C.P.; Cayton, T.E.; Buechl, K. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 22p. (CONF-870908—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000504/JAW.

From Course and workshop on physics of mirrors, reversed field pinches and compact tori; Varenna, Italy (1 Sep 1987).

The effects of pellet injection and gas puff refueling have been studied in the ZT-40M Reversed Field Pinch. Multiple deuterium pellets ($\leq$ 6 x 10^{19}D atoms/pellet) with velocities ranging from 300 to 700 m/sec have been injected into plasmas with n-bar/sub e/ $\sim$1 to 5 X $10^{19}m^{-3}$, I/sub phi/ $\sim$100 to 250 kA, T/sub e/(0) $\sim$150 to 300 eV and discharge durations of $\leq$ 20 msec. Photographs and an array D/sub α/ detectors show substantial deflection of the pellet trajectory in both the poloidal and toroidal planes, due to asymmetric ablation of the pellet by electrons streaming along field lines. To compensate for the poloidal deflection, the injector was moved up +14 cm off-axis, allowing the pellets to curve down to the midplane. In this fashion, central peaking of the pellet density deposition profile can be obtained. Both electron and ion temperatures fall in response to the density rise, such that β/sub θ/(β/sub θ/ identical to n-bar/sub e/(T/sub e/(0) + T/sub i/)/(B/sub θ/(a))^2) remains roughly constant. Energy confinement is momentarily degraded, and typically a decrease in F (F identical to B/sub phi/(a)/(B/sub phi/)) is seen as magnetic energy is converted to plasma energy when the pellet ablates. As a result of pellet injection at I/sub phi/ = 150 kA we observe T/sub e/(0) α n-bar/sub e//sup -.9 +- .1/, while the helicity based resistivity eta/sub k/ transiently varies as n-bar/sub e//sup .7 +- .1/. While the achievement of center-peaked density profiles is possible with pellet injection, gas puffing at rates strong enough to show a 50% increase in n-bar/sub e/ over a period of 10 msec ($\sim$150 torr-litres/sec) leads to hollow density profiles. The refueling requirements for parameters expected in the next generation RFPs (ZTH, RFX) can be extrapolated from these data using modified tokamak pellet ablation codes.

2676 **(LA-UR—87-3210) The rationale for the design of CPRF/ZTH, the next step in the US RFP [reversed field pinch] program.** Dreicer, H. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870908—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000486/JAW.

From Course and workshop on physics of mirrors, reversed field pinches and compact tori; Varenna, Italy (1 Sep 1987).

This paper briefly describes the design goals of the Reverse Field Pinch (RFP) device ZTH. Experiments are planned to study the effects of toroidal currents on ohmic heating and other areas of RFP confinement. (JDH)

2677 **(LA-UR—87-3283) Dielectric changes in neutron-irradiated rf window materials.** Frost, H.M.; Clinard, F.W. Jr. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 16p. (CONF-871036—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000482/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

Ceramics used for windows in ECRH heating systems for magnetically-confined fusion reactors must retain adequate properties during and after intense neutron irradiation. Of particular concern is a decrease in transmissivity, a parameter inversely related to

the product of dielectric constant K and loss tangent tanδ. Samples of polycrystalline Al_2O_3 and BeO were irradiated to 1 x 10^{26} n/m^2 at 660K in the EBR-II fission reactor, and the above properties subsequently measured at 95 GHz. It was found that ktanδ for both materials doubled, implying a doubling of thermal stresses and a consequent reduction of time-to-failure from an assumed one year to 20 min for beryllia and 2 s for alumina. In the case of BeO, a large increase in reflectance of the incident millimeter-wave power results from dielectrically uncompensated swelling. This phenomenon could significantly degrade source performance.

2678 **(LBL—23040) Heavy ion fusion system assessment: Final focus and transport model.** Brady, V.O.; Faltens, A.; Keefe, D.; Lee, E.P.; Hovingh, J. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000680/JAW.

This report discusses the trade-offs necessary to build an economical heavy ion fusion reactor. The principal concerns are the dynamics of the accelerated ion beam. 15 refs. (JDH)

2679 **(MPQ—110) MULTI: A computer code for one-dimensional multigroup radiation hydrodynamics.** Ramis, R.; Schmalz, R.; Meyer-ter-Vehn, J. (Max-Planck-Institut fuer Quantenoptik, Garching (Germany, F.R.)). Feb 1986. 63p. NTIS, PC E09; NTIS as TIB/B87-11108.

FORTRAN 77; Cray-1.

This report describes the basic physical equations as well as a computer code (MULTI) for the simulation of radiation hydrodynamics. The hydrodynamic equations are combined with a multigroup method for the radiation transport. The code, written in standard FORTRAN-77, is characterized by one-dimensional planar geometry with multilayer structure. A time-splitting scheme has been adopted with implicit finite-difference formulation (including hydrodynamics) in Lagrangean coordinates. Tabulated equations of state and opacities are used.

2680 **(ORNL/TM—10030) Compact Torsatron configurations.** Carreras, B.A.; Dominguez, N.; Garcia, L.; Lynch, V.E.; Lyon, J.F.; Cary, J.R.; Hanson, J.D.; Navarro, A.P. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001529/JAW.

Low-aspect-ratio stellarator configurations can be realized by using torsatron winding. Plasmas with aspect ratios in the range of 3.5 to 5 can be confined by these Compact Torsatron configurations. Stable operation at high B should be possible in these devices, if a vertical field coil system is adequately designed to avoid breaking of the magnetic surfaces at finite B. 17 refs., 21 figs., 1 tab.

2681 **(ORNL/TM—10164) Modular pump limiter systems for large tokamaks.** Uckan, T.; Klepper, C.C.; Mioduszewski, P.K.; McGrath, R.T. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001487/JAW.

Long-pulse (>10-s) operation of large tokamaks with high-power (>10-MW) heating and extensive external fueling will require correspondingly efficient particle exhaust for density control. A pump limiter can provide the needed exhaust capability by removing a small percentage of the particles, which would otherwise be recycled. Single pump limiter modules have been operated successfully on ISX-B, PDX, TEXTOR, and PLT. An axisymmetric pump limiter is now being installed and will be studied in TEXTOR. A third type of pump limiter is a system that consists of several modules and exhibits performance different from that of a single module. To take advantage of the flexibility of a modular pump limiter system in a high-power, long-pulse device, the power load must be distributed among a number of modules. Because each added module changes the performance of all the others, a set of design criteria must be defined for the overall limiter system. The design parameters for the modules are then determined from the system requirements for particle and power removal. Design criteria and parameters are presented, and the impact on module design of the state of the art in engineering technology is discussed. The relationship between modules are considered from the standpoint of flux coverage and shadowing effects. The results are applied to the Tore Supra tokamak. A preliminary conceptual design for the Tore Supra pump limiter system is discussed, and the design parameters of the limiter modules are presented. 21 refs., 12 figs.

2682 **(PRE-ZIAP—86-06) Analytic representations of thermonuclear reaction rates.** Haubold, H.J.; Mathai, A.M. (Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Astrophysik). Jun 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700132/JAW.

The basic physical principles common for all nonresonant and resonant thermonuclear reaction rates are taken as a basis to derive the standard forms of both types of reaction rates. Results are given for the closed-form representations of the standard nonresonant and resonant thermonuclear reaction rates in terms of a certain type of Meijer's G-function. Then, for physical reasons the non-resonant reaction rate with modified Maxwell-Boltzmannian distribution is considered. The mathematical method for the derivation of closed-form representations for the modified non-resonant reaction rate integral which is also suitable for numerical computations is given in detail. Some new techniques developed by the authors are used for deriving the results. The reaction rate systematics thus obtained in terms of Meijer's G-function is a contribution to Fowler's methods for the numerical computation of thermonuclear reaction rates.

2683 **(UCLA/PPG—1074) Progress report on PISCES: Plasma-surface interactions and materials research.** Conn, R.W.; Goebel, D.M.; Hirooka, Y.; LaBombard, B.; Leung, W.K.; Nygren, R. (California Univ., Los Angeles (USA). Plasma Physics Group). Jul 1987. Contract FG03-86ER52134. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001323/JAW.

This report briefly summarizes the status of the current PISCES experiments and near term plans for research by the PISCES Group in the areas of enhanced pumping of neutral gases by graphite, hydrogen recycling from activated graphite surfaces, erosion of graphite, new diagnostics for in-situ monitoring of erosion yield, pump limiter experiments, spectroscopy and diagnostic development. Experimental equipment includes the existing PISCES facility, AES/SIMS surface analysis facility, PISCES-B, which is now under construction, and experimental probes being developed for use in the Continuous Current Tokamak (CCT). 12 refs.

2684 **(UCLA/PPG—1084) ALT-I pump limiter experiments.** Goebel, D.M.; Conn, R.W.; Campbell, G.A.; Leung, W.K.; Dippel, K.H.; Finken, K.H.; Wolf, G.H.; Thomas, G.J.; Pontau, A.E.; Hsu, W. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering; Association Euratom-Kernforschungsanlage Juelich (Germany, F.R.). Inst. fuer Plasmaphysik; Sandia National Labs., Livermore, CA (USA)). Sep 1987. Contract FG03-85ER51069. 36p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88000822/JAW.

Results from the ALT-I pump limiter experiments in TEXTOR are presented. ALT-I has demonstrated control of the plasma density in a high recycling tokamak by pumping up to 15% of the core efflux. The closed pump limiter designs with restricted entrance geometries to reduce the backflow of neutral gas to the plasma remove over 50% of the ion flux incident on the collection slot. Up to 80% of the entrance ion flux is removed when the edge electron temperature is less than 10 eV and plasma-neutral gas interactions are minimized inside the limiter. Results from a 3-D Monte Carlo neutral gas transport code agree closely with these experimental results. The compound curvature of the head is found to distribute the heat over the surface as predicted in the original designs. Impurity removal experiments demonstrate that significant helium exhaust can be achieved with a pump limiter. During ohmic heating in TEXTOR, the energy and particle confinement times are proportional to the line averaged core density. With ICRH auxiliary heating, tau/sub E/ follow L-mode scaling independent of particle removal by the pump limiter. Pump limiter operation does not

directly modify the SOL plasma density and electron temperature, but controls the core plasma density by changing the global recycling at the boundary. The global particle confinement, the particle flux to the limiter, and the edge electron temperature follow the changes in the core density and auxiliary heating power. 25 refs.

2685 **(UCRL—15649-Vol.1) Photodetachment neutralizer development: Laser window design study: Volume 1, Summary: Final report.** (TRW Energy Development Group, Redondo Beach, CA (USA); Lawrence Livermore National Lab., CA (USA)). 30 Sep 1984. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000782/JAW.

Photodetachment neutralization (PDN) has been proposed as a major improvement to the gas cell neutralization utilized on current neutral beam heating systems for magnetic containment fusion devices. This PDN system will use a Chemical Oxygen Iodine Laser (COIL) to produce a light beam with photons of a near optimal wavelength which can be reflected back and forth across the path of the ion beam to create the necessary high density light "cloud" required for the photodetachment process. In a fusion device the neutral beam goes directly into the process vacuum chamber and therefore the oxygen iodine gas mixture in the laser must be isolated by a window from the neutral beam channel without loss of too much light or leakage of miniscule quantities of laser gas. The aerodynamic windows that have traditionally been used with chemical lasers are viewed as undesirable for the fusion application where any contamination of the fusion vacuum chamber by laser gas would be a big problem. It was concluded that the technological issues were uncertain enough that a verification by designing, fabricating, and testing of a demonstration window would be required before feasibility of such a window could be considered certain. The statement of work defined for this study consisted of two tasks: determination of the absorption characteristics of the proposed sapphire window material and the fluorocarbon coolant, and design and analysis of the proposed double disk heat exchanger window and demonstration test hardware.

2686 **(UCRL—15942) Inertial confinement fusion reactor cavity analysis: Progress report for the period 1 July 1986 to 30 June 1987.** Peterson, R.R.; MacFarlane, J.J.; Moses, G.A.; El-Afify, M.; Corradini, M.L. (Wisconsin Univ., Madison (USA). Fusion Technology Inst.; Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 79p. (UWFDM—725). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88000788/JAW.

This is a process report for research performed from July 1, 1986 to June 30, 1987, for Lawrence Livermore National Laboratory under subcontract number 9265205 with the project title: Inertial Confinement Fusion Reactor Cavity Analysis. This research generally considers the problems of vaporization and condensation of liquid metal or solid first surface materials in high yield ICF facilities such as reactors or high yield target test experiments. The past year's research consisted of 1.2 man years of effort on three tasks. These tasks were: verify the current vaporization-condensation models in CONRAD through literature surveys of relevant published data, and evaluation and comparison of these data with predictions by CONRAD on condensation phenomena, and with predictions by CONRAD, ZPINCH, and/or MIXERG on radiation phenomena, design a small-scale vaporization experiment by evaluating existing experimental facilities, selecting a primary facility, and conceptually designing an experiment complete with facility parameters and measurables, and design a small-scale condensation experiment including experimental parameters, measurables, and diagnostics. 48 refs.

2687 **(UCRL—94767) Recent implosion experiments at Nova.** Cable, M.D.; Lane, S.M.; Prussin, S.G.; Glendinning, S.G.; Munro, D.H.; Hatchett, S.P.; Estabrook, K.G.; Suter, L.J. (Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 4p. (CONF-860665—21). NTIS, PC A02. Order Number DE88000751/JAW.

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

Both electron (direct) and x-ray (indirect) driven implosions of DT targets have been done using ~20 kJ of 0.35 μm light from the ten beam Nova laser facility. The direct drive targets (glass microballoons with nominal dimensions of 1000 μm x 2 μm and DT pressures of 12 to 14 atm) produced neutron yields in excess of 10^{13} and fusion efficiencies >0.15%. Recent experiments will be described, with particular emphasis on measurements made using neutron diagnostics.

2688 **(UCRL—96676) The VISTA spacecraft: Advantages of ICF [Inertial Confinement Fusion] for interplanetary fusion propulsion applications.** Orth, C.D.; Klein, G.; Sercel, J.; Hoffman, N.; Murray, K.; Chang-Diaz, F. (Lawrence Livermore National Lab., CA (USA); Jet Propulsion Lab., Pasadena, CA (USA); Rockwell International Corp., Canoga Park, CA (USA). Energy Technology Engineering Center; National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). 2 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—2). NTIS, PC A02. Order Number DE88000417/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Inertial Confinement Fusion (ICF) is an attractive engine power source for interplanetary manned spacecraft, especially for near-term missions requiring minimum flight duration, because ICF has inherent high power-to-mass ratios and high specific impulses. We have developed a new vehicle concept called VISTA that uses ICF and is capable of round-trip manned missions to Mars in 100 days using A.D. 2020 technology. We describe VISTA's engine operation, discuss associated plasma issues, and describe the advantages of DT fuel for near-term applications. Although ICF is potentially superior to non-fusion technologies for near-term interplanetary transport, the performance capabilities of VISTA cannot be meaningfully compared with those of magnetic-fusion systems because of the lack of a comparable study of the magnetic-fusion systems. We urge that such a study be conducted.

2689 **(UCRL—97336) Review of x-ray spectroscopy from laser-produced plasmas.** Kauffman, R.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 19p. (CONF-8709143—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000755/JAW.

From International colloquium on UV and X-ray spectroscopy; Beaulieu-Sur-Mer, France (9 Sep 1987).

Recent progress in x-ray spectroscopy from laser plasmas is reviewed. Advances in the use of K-shell spectra as a diagnostic tool is discussed. Much activity in understanding complex spectra especially from Ne I and Ni I isoelectronic series have been made. Much of the progress has been due to observation of amplification from $\Delta n = 0$ transitions from these configurations. The spectroscopy will be discussed and examples of spectra of the amplified lines will be shown. Finally, recent work on using x-ray spectroscopy to diagnose high density implosions will be discussed. 33 refs.

2690 **Magnetic field behavior beyond the laser spot.** Goldman, S.R.; Schmalz, R.F. (Max-Planck-Institut f uer Quantenoptik, D-8046 Garching, Federal Republic of Germany). *Physics of Fluids;* **30**: No. 11, 3608-3615(Nov 1987).

A self-consistent, analytic solution for the two-dimensional, rotationally symmetric, time varying problem of the interaction of a laser plasma with its self-generated magnetic field has been determined at lateral locations away from the laser spot. The plasma is described by a two-fluid model, with the magnitude of the electron velocity much greater than the ion velocity. Increased spatial gradients in the density and velocity around the magnetic field maximum have been found. This leads to a double humped ion-velocity spectrum, which could be interpreted in terms of a two-temperature electron distribution, in qualitative agreement with experiment.

2691 **Laser-fusion targets for reactors.** Nuckolls, J.H.; Thiessen, A.R. (to Dept. of Energy, Washington, DC). US Patent 4,687,618. 18 Aug 1987. Filed date 2 Sep 1975. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a target having a centrally located substantially spherically configured quantity of solid fuel for implosion

by a pulse of laser energy and having no material therein with a Z of over about 13. The improvement consists of: means in spaced apart and non-contiguous relationship surrounding the fuel for at least providing an atmosphere about the fuel for ensuring electron transport around the fuel and enhancing subsequent implosion symmetry of the fuel, the fuel being configured as a hollow shell; the means consisting of at least one outer layer of substantially solid atmosphere forming material having a Z of 1-13. The atmosphere forms material comprising a shell positioned about the fuel defining a space therebetween, the space being filled with He, the fuel and the shell of atmosphere forming material being each composed of DT, the layer of atmosphere forming material being impacted and at least partially exploded by at least one separate and distinct laser prepulse to produce the atmosphere about the fuel prior to implosion of the fuel by the pulse of laser energy.

2692 **NOVA pulse power design and operational experience.** Whitham, K.; Larson, D.; Merritt, B.; Christie, D. (Lawrence Livermore National Lab., Livermore, CA). pp 12-17 of Pulse power for lasers. Burkes, T.R. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870132—).

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

Nova is a 100 TW Nd++ solid state laser designed for experiments with laser fusion at LLNL. The pulsed power for Nova includes a 58 MJ capacitor bank driving 5336 flashlamps with millisecond pulses and subnanosecond high voltages for electro optics. This paper summarizes the pulsed power designs and the operational experience to date.

2693 **Modular tokamak magnetic system.** Yang, Tien-Fang. (to Dept. of Energy). US Patent Application 6-932,560. 20 Nov 1986. 27p. Contract AC02-78ET51013. DE88000841 NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000841/JAW.

A modular tokamak system comprised of a plurality of interlocking modules. Each module is comprised of a vacuum vessel section, a toroidal field coil, modular saddle coils which generate a poloidal magnetic field and ohmic heating coils.

2694 **Folded waveguide coupler.** Owens, T.L. (to Dept. of Energy). US Patent Application 6-923,540. 27 Oct 1986. 26p. Contract AC05-84OS21400. DE88000838 NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000838/JAW.

A resonant cavity waveguide coupler for ICRH of a magnetically confined plasma. The coupler consists of a series of interleaved metallic vanes disposed within an enclosure analogous to a very wide, simple rectangular waveguide that has been "folded" several times. At the mouth of the coupler, a polarizing plate is provided which has coupling apertures aligned with selected folds of the waveguide through which rf waves are launched with magnetic fields of the waves aligned in parallel with the magnetic fields confining the plasma being heated to provide coupling to the fast magnetosonic wave within the plasma in the frequency usage of from about 50 to 200 mHz. A shorting plate terminates the back of the cavity at a distance approximately equal to one-half the guide wavelength from the mouth of the coupler to ensure that the electric field of the waves launched through the polarizing plate apertures are small while the magnetic field is near a maximum. Power is fed into the coupler folded cavity by means of an input coaxial line feed arrangement at a point which provides an impedance match between the cavity and the coaxial input line.

2695 **Thermonuclear inverse magnetic pumping power cycle for stellarator reactor.** Ho, D.D.M.; Kulsrud, R.M. (to Dept. of Energy). US Patent Application 6-911,533. 25 Sep 1986. 53p. Contract AC02-76CH03073. DE88000871 NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000871/JAW.

The plasma column in a stellarator is compressed and expanded alternatively in minor radius. First a plasma in thermal balance is compressed adiabatically. The volume of the compressed plasma is maintained until the plasma reaches a new thermal equilibrium. The plasma is then expanded to its original volume. As a result of the way a stellarator works, the plasma pressure during compression is less than the corresponding pressure during expansion. Therefore, negative work is done on the plasma over a complete cycle. This work manifests itself as a back-voltage in the toroidal field coils. Direct electrical energy is obtained from this voltage. Alternatively, after the compression step, the plasma can be expanded at constant pressure. The cycle can be made self-sustaining by operating a system of two stellarator reactors in tandem. Part of the energy derived from the expansion phase of a first stellarator reactor is used to compress the plasma in a second stellarator reactor. 9 figs., 4 tabs.

99 GENERAL AND MISCELLANEOUS

2696 **(DOE/OR/21702—T1) A national model at Howard University demonstrating private sector interrelationships that facilitate research in predominantly Black Colleges and Universities: Quarterly report, January 1, 1987-March 31, 1987.** (Howard Univ., Washington, DC (USA)). 1987. Contract FG05-86OR21702. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000160/JAW.

Plans for the May 19-20, 1987, forum on fostering research alliances are discussed. Research administration at Howard University is discussed. Future plans are outlined. (DLC)

2697 **(LA-UR—87-2966) Training engineering: A parametric approach to computer-based training design.** Trainor, M.S.; Andrews, A.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-871165—2). NTIS, PC A02. Order Number DE88000509/JAW.

From 9. interservice/industry training systems conference; Washington, DC, USA (30 Nov 1987).

Training engineering, a new model for computer-based training (CBT), has been devised and put into use by the Cognitive Engineering Design and Research Team (CEDAR) at Los Alamos National Laboratory. Training engineering is the application of scientific principles to the design, construction, and operation of efficient training systems. Such an approach is necessary because of the level of complexity CBT design and development has reached with the new advanced technologies. Instructional designers are under pressure to implement these new technologies more rapidly than has been required in the past, yet few models have emerged to aid designers in this process. Training engineering is such a model. It provides techniques for design and development that are derived from successful engineering techniques. This paper begins with a discussion of the engineering approach and then applies this approach to training. Examples from prototype CBT projects at Los Alamos are used throughout to illustrate the training engineering concept. 8 refs.

2698 **(SAND—87-1388C) Electronic publishing at Sandia National Laboratories: AOSS [Automated Office Support Systems] presentation.** Robinson, L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 26p. (CONF-8710132—6-Vugraphs). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000813/JAW.

From Department of Energy automated office support system conference; Denver, CO, USA (7 Oct 1987).

The Atex system for publishing is described. It will be replaced. The quest for the new system is described. The new system will be the Xy vision system. (DLC)

9901 Management

REFER ALSO TO CITATION(S) 912

2699 **(AERE-PR/TP—43) Theoretical Physics Divison progress report, October 1985-September 1986.** (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Feb 1987. 126p. H.M. Stationery Office, London, price Pound9.00.

The progress report for the Theoretical Physics Division of the United Kingdom Atomic Energy Authority, Harwell, 1985/6 is

presented. The Division's research programme is divided into four sections: 1) nuclear power (fuels, inspection and safety aspects), 2) radioactive waste management, 3) underlying research, and 4) non-nuclear contract research. The report contains a description of the research work carried out on these four topics in the above period.

2700 **(BMFT-FB-T—86-214) Development and testing of the methodical first steps in the evaluation of programmes of research in the field of non-nuclear energy. Final report.** Kausel, T.; Kreuz, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.)). Dec 1986. 112p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87753262/JAW.

The bases for an evaluation process are being developed with regard to the present first steps concerning the evaluation of project and programme and with the help of evaluation indicators for single projects and their aggregation. The process is being tested on selected BMFT-sponsored projects in the field of 'Non-Nuclear Energy Research'. Thereby present data from DAVOR, from the project records of the project carrier KFA, Juelich and the results of a mail survey at the enterprises in question are consulted. The results show that the process is in a position to carry out an evaluation of the programme on the basis of single projects and/or project-families. The transferability of the process to other R and D programmes is discussed, recommendations for the documentation of R and D programmes are proposed. With 23 refs., 7 figs.

2701 **(CNEA-NT—11/86) Progress report 1984-1985. Department of Physics.** (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Fisica). Apr 1986. 132p. NTIS (US Sales Only), PC A07/MF A01 . Order Number DE87703675/JAW.

English version of CNEA-NT--10/86. Abstract enclosed covers Spanish and English versions. .

The Department of Physics of the National Atomic Energy Commission reports on the advances and achievements performed during 1984-1985, within its three divisions: 1) Tandar Project; 2) Nuclear Physics (Nuclear Structure, Nuclear Reactions Intermediate Energies) and 3) Solid State Physics (Vibrational Spectroscopy, Cristallography and Phase transitions, Moessbauer Spectroscopy, Theoretical Solid State Physics, Crystal growth). Finally, a list of publications made by the personnel during said period, is included. (M.E.L.).

2702 **(CNEA-NT—22/86) Report 1984-1985. Department of Basic Research.** (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Dept. de Investigacion Basica). 1986. 111p. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703677/JAW.

A report is presented of the activities performed by the Department of Basic research of the Bariloche Atomic Center during the period 1984-1985. In this report, works on different subjects related to Physics, are grouped in six sections: Low temperatures, Atomic collisions, Metals, Neutrons and Reactors, Magnetic Resonances and Theory. In addition, a list of publications, made by the Department during said period, is included. (M.E.L.).

2703 **(CONF-8710160—3) Uses of the business model to meet the needs of functional managers.** Hardee, J.L. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000946/JAW.

From Southeast meeting of the Institute of Management Sciences; Myrtle Beach, SC, USA (8 Oct 1987).

Data resource managers for the Navy manpower, personnel, and training (MPT) community have long recognized that success in their strategic information systems planning efforts is dependent on an adequate understanding of the MPT business. In setting out to study the business, they have also recognized that the functional manager is reluctant to give up his or her time and knowledgeable resources without assurance that there will be some short-term benefit in the process. Most recently the Navy sponsor has been exploring ways of getting and keeping the enthusiastic participation of functional managers in building and maintaining business understanding. In support of these efforts, ORNL is currently testing several business modeling techniques that are intended to offer the short-term benefits necessary to attract management interest. The objective of this paper is to discuss the business modeling concepts being tested and briefly describe the prototyping effort.

2704 **(DOE/MA—0299/2) Department of Energy audit resolution, followup and internal control review activity: Quarterly management report as of June 30, 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Audit Liaison Div.). Sep 1987. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000673/JAW.

This report provides information to the Department of Energy (DOE) management on the status of audit followup, General Accounting Office (GAO), Inspector General (IG), and internal control review activity for the quarter ended June 30, 1987.

2705 **(INIS-mf—10963) Experience from excursion to Kernforschungszentrum Karlsruhe and to nuclear power plants at Goesgen-Daeniken in Switzerland and Bugey in France taking place from 6 to 12 October 1985.** Cech, J. (ed.). (Ceska Vedeckotechnicka Spolecnost, Prague (Czechoslovakia). Komise pro Jadernou Techniku). Apr 1986. 122p. (In Czech). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703560/JAW.

A detailed description of knowledge gained includes information on: 1. Centre for Nuclear Research, Karlsruhe, 2. Nuclear power plant in Bugey, 3. Nuclear power plant in Goesgen, 4. Experience with and results of the introduction of the probability estimate of the risk of nuclear power plant operation in the FRG, 5. Safety and development of nuclear fusion, 6. Operating reliability and life of steam generators of nuclear power plants, 7. Primary circuits of nuclear power plants with PWR reactors - pumps, pipes, valves - strength, operating reliability, residual life, 8. Disposal of radioactive wastes in Switzerland, 9. TASKA-research installation for fusion technology, 10. Development of fast reactors and their use in power systems. (Ha).

2706 (INIS-mf—11001, pp 192-196) **Methodic issues of NPP personnel professional selection.** Kuznetsova, Zh.Ya. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Basic methodic principles related to the NPP personnel selection are considered. Suggestions on the selection organization are given as well as some psycho-physiological methods of the personnel professional fitness estimating. The personnel distribution over the working places with respect to psycho-phisiological abilities has been shown to represent a way to improvement of NPP radiation safety. 13 refs.

2707 (INIS-mf—11001, pp 208-217) **GDR NPP personnel training in the field of nuclear safety.** Chirne, G.; Shrajter, V.; Krauz, V. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780026/JAW. (CONF-8205317—Pt.3).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Requirements have been developed to qualification of nuclear safety specialists, administration and personnel subjected to irradiation due to their profession. Training system of these persons is described, including the following: learning in the field of radiation safety as a part of professional training; special courses; training in the system of State Administration of nuclear safety and radiation protec tion; training at trade-improvement courses. A program of 12 days theoretical and practical training course is presented. 6 refs.; 1 tab.

2708 **(INS—608) Research activities by INS cyclotron facility. List of publications in 1975-1986.** (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Oct 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703584/JAW.

Research activities made by the cyclotron facility at Institute for Nuclear Study(INS), University of Tokyo, have been reviewed in terms of the associated scientific publications. They include experimental works on low-energy nuclear physics, accelerator technology, radiation physics and other applications in interdisciplinary fields. The publications are classified into the following four categories. A: Internal reports published in INS. B: Publications in international scientific journals on experimental research works done by the cyclotron facility at INS. Those made by outside users are also included. C: Publications in international scientific journals on experimental low-energy nuclear physics, which have been done by INS staff members using facilities outside INS. D: Contributions to international conferences. 314 refs.

2709 **(MLM—3457(OP)) Improved maintenance productivity through software application.** Rohrig, S.D. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 7p. (CONF-8709154—1). NTIS, PC A02. Order Number DE88000728/JAW.

From International maintenance conference; Cincinnati, OH, USA (14 Sep 1987).

Some twelve years ago, MRC - Mound was one of the first Department of Energy (DOE) weapons complex sites to define and implement an engineering performance standards system to aid in the management of site maintenance operations. Over succeeding years, the scope of the system was broadened to include preventive maintenance and equipment management. Portions of the system were eventually automated through applications programming utilizing Mound's mainframe computer. The Automated Maintenance Management Operations, AMMO, software package will support all the principal functions of the maintenance mission at Mound. In the subsequent pages, a few unique features of the AMMO System will be highlighted. Also to be discussed, will be some of the productivity philosophies that influenced the AMMO design, as well as, the mechanisms within the system that will monitor the success of the system in achieving the desired results. Piror to this discussion, however, an overview of Mounds's present maintenance work order execution must be briefly discussed. The AMMO System software was designed around this mode of operation while incorporating some innovative new philosophies.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 2068

2710 **(AD-A—182935/7/XAB) Parallel and distributed computing. Final report, 1 June 1985-30 November 1986.** Kaplansky, I.; Karp, R.M. (Mathematical Sciences Research Inst., Berkeley, CA (USA)). 11 Dec 1986. 16p. NTIS, PC A02/MF A01.

A workshop on the complexity of parallel and distributed computation was held in May 1986. It had 21 speakers and 141 participants; their interests ranged from practical questions about the architecture of parallel and distributed systems to highly theoretical questions about the complexity of parallel computation. A panel discussion was held on the topic Bridging the Gap Between the Theory and Practice of Parallel and Distributed Computing. The main focus of the workshop was a set of mathematical and algorithmic issues that underlie the efficient use of the massively parallel computers that are just beginning to come into use. Several of the lectures were concerned with efficient algorithms for such computers. Other lectures were concerned with the problems of synchronization, load-sharing, and communication between processors in such systems. A third major theme was the reliable operation of such systems in the presence of faulty processors.

2711 **(AD-A—182976/1/XAB) Fast algorithms for the CMU (Carnegie-Mellon University) attached processor system. Final report, 1 September 1985-31 August 1986.** Gunzburger, M.D. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mathematics). 1986. 4p. NTIS, PC A02/MF A01.

This project concerned research on developing fast algorithms for implementation on a parallel-processing system. Titles of research papers resulting from this effort include the following: Least-squares methods for fourth-order problems; Least-squares methods for problems with corner singularities; Finite-element methods for the streamfunction-vorticity equations; and On substructuring algorithms; solution techniques for the numerical solution of partial differential equations; On central difference approximations to general second-order elliptic equations; and A modified defect correction algorithm for the solution of singularly perturbed differential equations.

2712 **(AD-A—183053/8/XAB) Intelligent acquisition support tool. Final report.** Adler, R.M. (Mitre Corp., Bedford, MA (USA)). May 1987. 85p. (MTR—10188). NTIS, PC A05/MF A01.

This paper describes SEIMOAR, an artificial intelligence-based acquisition support tool. SEIMOAR (Systems Environment for Intelligent Modeling and Analysis of Requirements) provides a framework for representing and analyzing the functionality, structure, and behavior of C3I systems. Functional and structural information is captured via frame-based templates, in a modeling library that depicts common C3I system capabilities and components. System models are constructed by copying and editing appropriate templates. SEIMOAR also incorporates an object-oriented simulator to support dynamical modeling of system behaviors. An example acquisition task illustrates SEIMOAR's current capabilities. Work in progress on tool extensions is also outlined.

2713 **(AD-A—183196/5/XAB) AI (artificial intelligence) as the ultimate enhancer of protocol design.** Cohen, D.; Finnegan, J. (University of Southern California, Marina Del Rey (USA). Information Sciences Inst.). 24 Apr 1987. 14p. (ISI/RS—87-193). NTIS, PC A02/MF A01.

Pub. in Proceedings of the Annual Artificial Intelligence and Advanced Computer Technology Conference (3rd), 329-337, 22-24 Apr 1987.

Most computer-communication protocols do not use the available resources very efficiently. For example, they pay expensive performance penalties in order to achieve reliable connections. This paper demonstrates how standard artificial-intelligence techniques applied to message transmission can result in vast improvements by making those mechanisms smart. Such an Expert System, coupled with various heuristics common in the communication domain, yields high-performance reliable connections for message interchange. This protocol is the first serious use of AI techniques to result in significant and substantial improvement of communication technology. The protocol is designed to maximize the well known CIQ - Communication Intelligence Quotient – function. The CIQ is defined as the radio of the amount of information conveyed by a communication transaction (e.g., a message) and the amount of resources consumed in successfully communicating it. The new protocol is called HighQ, because it is designed to achieve a very high CIQ in message communication. The authors start by defining CIQ, the objective function that we wish to optimize. Then it is shown how conventional optimization techniques provide slight benefit the really large gains require sophisticated AI techniques and their use drastically minimizes the transmission cost, even eliminating it in some cases.

2714 **(AD-A—183216/1/XAB) Methodologies for concurrent programming. Final report for 1 March 1986-28 February 1987.** Misra, J. (Texas Univ., Arlington (USA). Dept. of Computer Science). 28 Feb 1987. 22p. NTIS, PC A02/MF A01.

This document proposes a unifying theory for the development of programs for a variety of architectures and applications. The computational model is unbounded nondeterministic iterative transformations of the program state. Transformations of the pro-

gram state are represented by multiple assignments. The theory attempts to decouple the programmer's thinking about a program and its implementation on an architecture; attempt is made to separate the concerns of what from those of where, when, and how. Details about implementations are considered in mappings of programs to architectures. The author hoped to demonstrate that we could develop, specify, and refine solution strategies independent of architectures. The utility of a new approach is suspect, especially when it is a radical departure from the conventional. Therefore, the author made a conscientious effort to apply his ideas to a number of architectures and application domains. The experience is encouraging.

2715 **(AD-A—183223/7/XAB) Parallel image processing and image understanding. Final report, April 1985-March 1986.** Rosenfeld, A. (Maryland Univ., College Park (USA). Center for Automation Research). 31 Mar 1986. 10p. NTIS, PC A02/MF A01.

This research was conducted to obtain better methods for image processing. It focused on several aspects of this problem, including parallel algorithms for image processing, knowledge-based techniques for image understanding, and modeling images using shape and texture. Eighteen technical reports produced will also appear as published papers in journals. In the paper Holes and Genus of 3D images, it was shown that certain geometric invariants of a digital image (number of components, number of holes, and number of cavities) do not determine the topology (in the sense of connectivity) of the image refuting the commonly believed assumption that they do. This research lays the groundwork for research on digital and computational geometry of 3D images. In the paper Hough Transform Algorithms for Mesh-Connected SIMD Parallel Processors, several methods of Hough transform computation are studied in terms of suitability for implementation on a parallel processor, providing a valuable tool for straight-line detection.

2716 **(AD-A—183283/1/XAB) Artificial intelligence: expert systems for corps tactical planning and other applications. Study project.** Back, J.F.; Barbone, A.F.; Crocker, G.K.; Johnson, L.M.; Jones, L.D. (Army War Coll., Carlisle Barracks, PA (USA)). 23 Mar 1987. 133p. NTIS, PC A07/MF A01.

Systems such as those that play games, diagnose engine problems, or organize cargo loads in ships are all examples of artificial intelligence. The sub-discipline of expert systems deals with computerized imitation of the reasoning of judgment process of human experts. CECOM's expert system for tactical planning draws its tactical expertise from the US Army War College students that comprise study group. Computer scientists who have a long-term commitmeat to the CECOM project work with the study group experts to extract and understand what rules, guidelines, or thought processes the group uses to generate a tactical plan for a Corps operation. The computer scientist takes these lists of information and converts them into computer knowledge which eventually becomes rules that will govern program output. In the heuristic environment of tactical planning, it would not be unreasonable to expect the finished expert system to contain between 20 and 50,000 such rules. The multi-year approach to the project is driven home by the recognition that a hand-crafted expert system might have 20 rules after the first year of effort. By working with CECOM's knowledge engineers, participating in numerous group sessions, going on TDY trips, and reading extensively, study group members developed an appreciation for some of the difficulties and opportunities associated with the use of artificial intelligence in its various military applications.

2717 **(ANL—87-36) An approach to implementing state space searches on heterogeneous systems of multiprocessors.** Glickfeld, B.; Overbeek, R. (Northern Illinois Univ., Dekalb (USA); Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001321/JAW.

We report on experiments run on a set of shared-memory multiprocessors. Our goal was to demonstrate that one could conveniently utilize a set of shared-memory multiprocessors cooperatively working on typical state-space searches. We utilized a technology for writing portable code for multiprocessors, coded three depth-first state-space searches, and ran them on a set of multiprocessors. The final problem used substantial resources (over 65 hours on a single processor) and was successfully distributed over four distinct shared memory multiprocessors (2 Sequents and 2 Encores), reducing the time to perform the computation to slightly over 2 hours. 4 refs.

2718 **(ANL—87-40) A review and analysis of Fortran 8x.** Smith, B.T. (ed.). (Argonne National Lab., IL (USA)). Oct 1987. Contract W-31109-ENG-38. 51p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88001320/JAW.

The ANSI Standards Subcommittee X3J3 on Fortran has recently completed a draft proposed standard for the Fortran programming language. The draft proposed standard, known informally as Fortran 8x, is a revision of the current standard X3.9-1978, known informally as Fortran 77. This report is a review of Fortran 8x and consists of a series of six articles. The first article gives a general overview of Fortran 8x. The next three articles give brief discussions of the array facilities; the enhanced numeric facilities; and user-defined data types, procedure interfaces, and the new program unit called a module. The fifth article provides a brief analysis of the controversial issues discussed by X3J3 (including both the accepted and rejected facilities for Fortran 8x). The sixth article gives a brief comparison with Ada. The report concludes with a summary giving information on how and where to express opinions of the draft proposed standard. 4 refs.

2719 **(ANL/MCS-TM—95) An exact penalization viewpoint of constrained optimization.** Burke, J.V. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). Aug 1987. Contract W-31109-ENG-38. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001477/JAW.

The published work on exact penalization is indeed vast. Recently this work has indicated an intimate relationship between exact penalization, Lagrange multipliers, and problem stability or calmness. In the present work we chronicle this development within a simple idealized problem framework, wherein we unify, extend, and refine much of the known theory. In particular, most of the foundations for constrained optimization are developed with the aid of exact penalization techniques. Our approach is highly geometric and is based upon the elementary subdifferential theory for distance functions. It is assumed that the reader is familiar with the theory of convex sets and functions. 54 refs.

2720 **(ANL/TM—452) Using the Apple LaserWriter at ANL.** Errion, S.M.; Thommes, M.M. Caruthers, C.M. (ed.). (Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001319/JAW.

Using the Apple LaserWriter at ANL (ANL/TM 452) explains how Argonne computer users (with CMS, MVS, or VAX/VMS accounts) can print quality text and graphics on the Apple LaserWriter. Currently, applications at Argonne that are compatible with the Apple LaserWriter include Waterloo Script, CA/ISSCO graphics software (i.e., Cuechart, Tellagraf, and Disspla), SAS/Graph, ANSYS (version 4.2), and some personal computer text and graphics software. This manual does not attempt to cover use of the Apple LaserWriter with other applications, though some information on the handling of PostScript-compatible files may be valid for other applications. Refer to the documentation of those applications to learn how they work with the Apple LaserWriter. Most of the information in this manual applies to the Allied Linotype L300P typesetter in Building 222. However, the typesetter is not a high volume output device and should be used primarily for high quality (1250 and 2500 dots per inch) final copy output for Laboratory publications prior to making printing plates. You should print all drafts and proof pages on LaserWriers or other printers compatible with the PostScript page description language. Consult with Graphic Arts (at extension 2-5603) to determine the availability of the typesetter for printing the final copy of your document or graphics application. Since the Apple LaserWriter itself produces good quality output (300 dots per inch), we expect that most internal documents consisting of test or graphics will continue to be

printed at LaserWriters distributed throughout the Laboratory. 5 figs., 2 tabs.

2721 **(CONF-860470—3) Using DATATRIEVE as a COBOL code generator.** Duncan, L.D. (Oak Ridge National Lab., TN (USA)). Apr 1986. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE88000599/JAW.

From DECUS symposium; Dallas, TX, USA (27 Apr 1986).

This paper describes the use of DATATRIEVE to automatically generate large blocks of COBOL code for use in a computer aided instruction application. Pro/DATATRIEVE was used to store information describing the attributes of screens that make up the instruction and tests, and to maintain data on expected student responses for each screen. DATATRIEVE procedures were used to create standard, error-free COBOL code that controls the presentation and order of flow of the screens within the lessons and tests. The code generated by DATATRIEVE was incorporated into skeleton COBOL programs through use of the COPY statement. This project involves the use of DATATRIEVE on a DEC Professional-380. The generated code segments were electronically transmitted to a Honeywell DPS-6 minicomputer where the application was compiled and executed. However, the procedures used for the code generation could be applied to any DATATRIEVE implementation and any application system that requires standardized procedures for processing a variety of functions (i.e., transactions).

2722 **(CONF-871043—2) Using AI in the preparation of budget submissions.** Hwang, Ho-Ling; Emrich, M.L.; Morris, J. (Oak Ridge National Lab., TN (USA)). 14 Oct 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000304/JAW.

From 2. international symposium on methodologies for intelligent systems; Charlotte, NC, USA (14 Oct 1987).

This paper describes an automated budget preparation system that was developed using an expert system shell. Capabilities, operating environment, and limitations of the tool are discussed. Specific features of the budget preparation system are covered.

2723 **(CONF-871101—4) ADGEN: An automated adjoint code generator for large-scale sensitivity analysis.** Pin, F.G.; Oblow, E.M.; Horwedel, J.E.; Lucius, J.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE87010900/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

This paper describes a new automated system, named ADGEN, which makes use of the strengths of computer calculus to automate the costly and time-consuming calculation of derivatives in FORTRAN computer codes, and automatically generate adjoint solutions of computer codes.

2724 **(CONF-8707114—1) Oscillation theory for linear second-order differential systems.** Kaper, H.G.; Kwong, Man Kam. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87011393/JAW.

From Oscillation, bifurcation and chaos conference; Toronto, Canada (14 Jul 1987).

This article is concerned with the oscillatory behavior at infinity of the solution y:[a,∞) → R/sup n/ of a system of second-order differential equations, y″(t) + Q(t)y(t) = 0, t ∈[a,∞); Q is a continuous function on [a,∞), whose values are real symmetric matrices of order n. It is shown that the solution is oscillatory at infinity if the largest eigenvalue of the matrix ∫/sub a/ Q(t) dt is sufficiently large on a sufficiently large set of t-values. 11 refs.

2725 **(CONF-8710153—1-Vugraphs) Combat modeling with partial differential equations.** Protopopescu, V. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014790/JAW.

From ACMP annual meeting; Washington, DC, USA (5 Oct 1987).

This paper contains viewgraphs on the use of partial differential equations to model war strategies and combat tactics. (LSP)

2726 **(CONF-8710160—1) ADP [Automated Data Processing] cost estimating heuristics.** Sadlowe, A.R.; Arrowood, L.F.; Jones, K.A.; Emrich, M.L.; Watson, B.D. (Oak Ridge National Lab., TN (USA)). 11 Sep 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE88000579/JAW.

From Southeast meeting of the Institute of Management Sciences; Myrtle Beach, SC, USA (8 Oct 1987).

Artificial Intelligence, in particular expert systems methodologies, is being applied to the US Navy's Automated Data Processing estimating tasks. Skilled Navy project leaders are nearing retirement; replacements may not yet possess the many years of experience required to make accurate decisions regarding time, cost, equipment, and personnel needs. The potential departure of expertise resulted in the development of a system to capture organizational expertise. The prototype allows inexperienced project leaders to interactively generate cost estimates. 5 refs.

2727 **(CONF-8710160—2) Automated software development tools in the MIS [Management Information Systems] environment.** Arrowood, L.F.; Emrich, M.L. (Oak Ridge National Lab., TN (USA)). 11 Sep 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02. Order Number DE88000589/JAW.

From Southeast meeting of the Institute of Management Sciences; Myrtle Beach, SC, USA (8 Oct 1987).

Quantitative and qualitative benefits can be obtained through the use of automated software development tools. Such tools are best utilized when they complement existing procedures and standards. They can assist systems analysts and programmers with project specification, design, implementation, testing, and documentation. Commercial products have been evaluated to determine their efficacy. User comments have been included to illustrate actual benefits derived from introducing these tools into MIS organizations.

2728 **(DOE/ER/25026—12) A comparison of adaptive refinement techniques for elliptic problems.** Mitchell, W.F. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Sep 1987. Contract FG02-87ER25026. 49p. (UIUCDCS-R—87-1375; UILU-ENG—87-1763). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000805/JAW.

Adaptive refinement has proved to be a useful tool for reducing the size of the linear system of equations obtained by discretizing partial differential equations. We consider techniques for the adaptive refinement of triangulations used with the finite element method with piecewise linear functions. Several such techniques have been developed differing mainly in the method for dividing triangles and the method for estimating errors. We describe four methods for dividing triangles and eight methods for estimating errors. Angle bounds for the triangle division methods are compared. All combinations of triangle divisions and error estimates are compared in a numerical experiment using a population of eight test problems with a variety of difficulties (peaks, boundary layers, singularities, etc.). The comparison is based on the L/sub proportional to/ norm of the error vs. the number of vertices. It is found that most, but not all, of the methods produce asymptotically optimal grids and that the number of vertices needed for a given error rarely differs by more than a factor of two. 17 refs., 12 figs.

2729 **(DOE/ER/25026—13) The shifted Adams method for ordinary differential equations.** Tam, Hon-Wah. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Sep 1987. Contract FG02-87ER25026. 31p. (UIUCDCS-R—87-1376; UILU-ENG—87-1764). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000810/JAW.

Exponential fitting is known to be effective for nonstiff ordinary differential equations, although there has been no way of systematically implementing it. This report extends the Adams method by incorporating exponential fitting. The user must supply either a real or a complex conjugate pair of shifting factors. 7 refs., 5 figs.

2730 (DP-MS—87-108) Input/output technologies: An overview of image scanning, storage, and display. Hudson, B.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 14p. (CONF-8710132—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014837/JAW.

From Department of Energy automated office support system conference; Denver, CO, USA (7 Oct 1987).

In recent years, price reductions and advances in technology have increased the availability of digital image scanners for personal minicomputers. Optical disk technology, which is known for its high capacity storage, has accompanied the advent of image scanning. Limitations still exist in the resolution and display capabilities of scanned images. This paper presents a brief introduction to the concepts and considerations of image scanning, storage, and display.

2731 (EGG-SPAG—7818) Parallelization of hydrocodes on the Intel Hypercube: Part 2. Hicks, D.L.; Liebrock, L.M.; Mousseau, V.A.; Mortensen, G.A. (Michigan Technological Univ., Houghton (USA); EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1987. Contract AC07-76ID01570. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001591/JAW.

In a previous report (EGG-SPAG-7682, April 1987) we described the first results of our computational experiments on the Intel iPSC-286 (a 32 node hypercube with nodes based on the 80286/80287 chip) with certain algorithms for concurrent computational continuum dynamics. The first results were disappointing: the best speedup factors were less than 4 out of a possible 32. Modifications of our earlier algorithms to better fit the iPSC architecture led to significant improvement: the best speedup factors on these improved algorithms are now in excess of 24 out of 32. The earlier parallel algorithms had speedup efficiencies of 90% or better on several other parallel processors, namely, the HEP, ELXSI/10, and CRAY X-MP/4. These machines handled the global communications requird by the earlier parallel algorithms more efficiently than the iPSC. The algorithmic modifications yielding the greatest speedup factor improvements reduced the amount of communications relative to the amount of computations. 11 refs., 1 tab.

2732 (JAERI-M—86-159) Structured programming supporting tool EOS77. Tokuda, Shinji; Tsunematsu, Toshihide; Takeda, Tatsuoki. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 36p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703602/JAW.

As a part of the project TRITON a preprocessor (EOS77 preprocessor) which supports structured programming was developed. EOS77 is an uppercompatible version of the preprocessor EOS and is constructed so as to generate FORTRAN 77 programs. EOS77 provides other functions to facilitate structured programming. The EOS77 preprocessor system is very useful in development and use of large-scale computer codes. This report is a user's manual of this system.

2733 (JAERI-M—86-168) Investigation of an inventory calculation model for a solvent extraction system and the development of its computer programme - SEPHIS-J. Ihara, Hitoshi; Nishimura, Hideo; Ikawa, Koji; Ido, Masaru. (Japan Atomic Energy Research Inst., Tokyo). Nov 1986. 94p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703607/JAW.

In order to improve the applicability of near-real-time materials accountancy (N.R.T.MA) to a reprocessing plant, it is necessary to develop an estimation method for the nuclear material inventory at a solvent extraction system under operation. For designing the solvent extraction system, such computer codes as SEPHIS, SOLVEX and TRANSIENTS had been used. Accuracy of these codes in tracing operations and predicting inventories in the extraction system had been discussed. Then, much better codes, e.g., SEPHIS Mod4 and PUBG, were developed. Unfortunately, SEPHIS Mod4 was not available in countries other than the USA and PUBG was not suitable for use with a mini-computer which would be practical as a field computer because of quite a lot of computing time needed. The authors investigated an inventory estimation model compatible with PUBG in functions and developed the corresponding computer programme, SEPHIS-J, based on the SEPHIS Mod3 code, resulting in a third of computing time compared with PUBG. They also validated the programme by calculating a static state as well as a dynamic one of the solvent extraction process and by comparing them among the programme, SEPHIS Mod3 and PUBG. Using the programme, it was shown that the inventory changes due to changes of feed flow and concentration were not so small that they might be neglected although the changes of feed flow and concentration were within measurement errors.

2734 (JAERI-M—86-177) MCVIEW: a radiation view factor computer program for three dimensional geometries using Monte Carlo method. Ikushima, Takeshi. (Japan Atomic Energy Research Inst., Tokyo). Dec 1986. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703608/JAW.

A Computer program MCVIEW calculates the radiation view factor between surfaces for three dimensional geometries. MCVIEW was developed to calculate view factors for input data to heat transfer analysis programs TRUMP, HEATING-5, HEATING-6 and so on. In the paper, brief illustration of calculation method using Monte Carlo for view factor is presented. The second section presents comparisons between view factors of other methods such as area integration, line integration and cross string and Monte Carlo methods, concerning with calculation error and computer execution time. The third section provides a user's input guide for MCVIEW.

2735 (JAERI-M—86-183) Data storage system for fusion experiment. Takada, Susumu; Matsuda, Toshiaki; Miura, Yukitoshi; Mori, Masahiro; Kawakami, Tomohide; Matoba, Tohru. (Japan Atomic Energy Research Inst., Tokyo). Jan 1987. 24p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703610/JAW.

An appropriate archiving and an effective using of experimental data are examined in the field of fusion research. Several computer systems in tokamak type fusion experimental devices are reviewed, and then, indispensable functions and optimum utilizing form of data storage system are discussed from the standpoint of computer technology. According to these considerations, the data storage system was made in the JFT-2M tokamak.

2736 (JAERI-M—87-073) Development of identifier programs using model reference adaptive system. Suzudo, Tomoaki. (Japan Atomic Energy Research Inst., Tokyo). May 1987. 28p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750050/JAW.

The computer program GADAPT for identifying system dynamics using a model reference adaptive system MRAS has been developed. This program involves the algorithm of parallel identifier with fixed compensator (FCP) whose adaptive gains are time-variant. It is known that if the parameters in a linear compensator are selected properly, this algorithm is asymptotically stable. For the selection of parameters, the program LIAPU has been developed. This program needs a priori information of the system to be identified in advance. For the purpose of evaluating the program GADAPT, some simulation tests have been done. For transforming a model described as a continuous system into the corresponding discrete system model, program SABUN has been developed. As the result of the tests using a linear and second-order model, it has been confirmed that the present method is valid.

2737 (KFKI—1987-17/M) Collection of scientific papers in collaboration with Joint Institute for Nuclear Research, Dubna, USSR and Central Research Institute for Physics, Budapest, Hungary Pt. 5. Algorithms and programs for solution of some problems in physics. Nemeth, G.; Lobanov, J.J. (eds.). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Apr 1987. 159p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700125/JAW.

The results of JINR (Dubna) - CRIP (Budapest) collaboration in the field of numerical and computer methods for solving physical problems are reported. The topics cover pure mathematical problems with applications in organization theory, numerical data handling, construction and simulation of physical devices and reinterpretation of current problems in mathematical physics. (D.Gy.).

2738 (KFKI—1987-17/M, pp 27-51) **Determination of maximum error in best Chebyshev rational approximation for some elementary functions.** Popov, B.A. (AN Ukrainskoj SSR, Lvov. Fiziko-Mekhanicheskij Inst.). Apr 1987. (In Russian). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700125/JAW.

In Collection of scientific papers in collaboration with Joint Institute for Nuclear Research, Dubna, USSR and Central Research Institute for Physics, Budapest, Hungary Pt. 5. Algorithms and programs for solution of some problems in physics.

Approximative expressions of maximum error in best Chebyshev (absolute and relative) rational approximation for C/sup αx/, X/sup α/, log/sub c/x, 1/log/sub c/x on small interval is estimated. The comparison with exact values of error is presented. Pt. 4: KFKI–1983-21; 18 refs.; 5 tables.

2739 (LA-UR—87-2329) **Parallel superconvergent multigrid.** Frederickson, P.O.; McBryan, O.A. (Los Alamos National Lab., NM (USA); Cornell Univ., Ithaca, NY (USA). Theory Center). 1987. Contract AC02-76ER03077;W-7405-ENG-36. 21p. (CONF-8704205—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013153/JAW.

From 3. conference on multigrid methods; Copper Mountain, CO, USA (6 Apr 1987).

We describe a class of multiscale algorithms for the solution of large sparse linear systems that are particularly well adapted to massively parallel supercomputers. While standard multigrid algorithms are unable to effectively use all processors when computing on coarse grids, the new algorithms utilize the same number of processors at all times. The basic idea is to solve many coarse scale problems simultaneously, combining the results in an optimal way to provide an improved fine scale solution. As a result, convergence rates are much faster than for standard multigrid methods - we have obtained V-cycle convergence rates as good as .0046 with one smoothing application per cycle, and .0013 with two smoothings. On massively parallel machines the improved convergence rate is attained at no extra computational cost since processors that would otherwise be sitting idle are utilized to provide the better convergence. On serial machines the algorithm is slower because of the extra time spent on multiple coarse scales, though in certain cases the improved convergence rate may justify this - particularly in cases where other methods do not converge. In constant coefficient situations the algorithm is easily analyzed theoretically using Fourier methods on a single grid. The fact that only one grid is involved substantially simplifies convergence proofs. A feature of the algorithms is the use of a matched pair of operators: an approximate inverse for smoothing and a superinterpolation operator to move the correction from coarse to fine scales, chosen to optimize the rate of convergence.

2740 (LA-UR—87-2806) **The performance of minisupercomputers: Alliant, Convex, and SCS [Scientific Computer Systems].** Wasserman, H.J.; Simmons, M.L.; Lubeck, O.M. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 12p. (CONF-8708148—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87014765/JAW.

From Vector and parallel processing in computational science; Liverpool, UK (25 Aug 1987).

Recently several computers have appeared whose architectures feature many, if not all, of the characteristics of supercomputers, but whose electronic technology uses less expensive and more readily available components. Such machines have been labeled "minisupercomputers." Currently, this class of computers includes those manufactured by Convex, Alliant, and Scientific Computer Systems (SCS). The strategy of these minisupercomputer vendors is to produce a machine that may not provide as much absolute performance as the high-end supercomputers, but exhibits a comparable or better price-performance ratio. While it is not the goal of this paper to comment on the specific price effectiveness of any particular machine, we believe that a proper evaluation of the minisupercomputers should include price data. This paper presents a detailed performance comparison of the Convex C-1, Alliant FX/8, and SCS-40 minisupercomputers. While the Convex C-1 is functionally similar to the CRAY-1 supercomputer, the SCS-40 actually emulates a CRAY X-MP/2, running the same instruction set and providing CRAY X-MP software. The Alliant series of machines are multiprocessors, containing up to eight processors (called computational elements, or CEs) that can run separate processes or cooperate on a single application. The Alliant system also includes a compiler that automatically attempts to partition a code for concurrent execution on several processors. In the first sections of this paper, the single processor performance of the FX/8 is compared with that of the C-1 and the SCS-40, as well as with a Digital Equipment Corporation (DEC) VAX 8600. In a later section, the parallel processing performance of the FX/8 is described. 21 refs.

2741 (LBL—21522) **A network definition and solution of simulation problems.** Anderson, J.L. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000675/JAW.

Most software tools currently used to solve simulation problems are monolithic FORTRAN programs. Such programs retard advances in modeling by being inflexible, hard to modify, and hard to use. Simulation programs can be defined in terms of a network of physical objects and links. The network concept allows modeling algorithms to be defined as abstract data types called objects. Objects separate the details of a model from the interface needed to use it in a simulation. This allows a network simulation program to be more flexible and more easily modified than traditional simulation programs. A network simulation program kernel that provides basic tools for simulations is described. The kernel provides a language designed to define simulation networks and a solution technique for simulation problems that works well with network definitions. This method is analyzed and shown to be faster than traditional solution methods by a significant factor. A network simulation problem kernel providing data abstraction should accelerate advances in modeling by providing facilities to create flexible, easily modified simulation programs. 24 refs., 18 figs., 3 tabs.

2742 (LBL—23898) **FDDI [Fiber Distributed Data Interface] as a backbone for large campus Ethernet networks.** Fink, R.L. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 5p. (CONF-8710156—1). NTIS, PC A02. Order Number DE88000469/JAW.

From 11. international fiber optic communications and local area networks conference; Anaheim, CA, USA (26 Oct 1987).

Many large campus environments rely heavily on multiple Ethernet Local Area Networks, LANs, interconnected with bridges and/or routers, operating over Backbone LANs also based on Ethernet. Although the use of Ethernets for direct user attachments will be viable for quite some time to come, the use of Ethernets in the Backbone is more limited. A Fiber Distributed Data Interface (FDDI) Backbone, interconnected to existing Ethernets with FDDI to Ethernet MAC level bridges, will provide the principal evolutionary path for these large campus networks due to its combination of high speed, low delay time and reliability. 7 refs.

2743 (MLM—3449(OP)) **Storing photomicrographs on optical laser disks.** Ransick, M.H. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 14p. (CONF-8707113—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013747/JAW.

From International Metallurgical Society symposium; Monterey, CA, USA (27 Jul 1987).

Storing duplicate photomicrographs is a common practice at many service laboratories and is a requirement for many programs performed for the government. In a large service lab, storing photographs permanently or for a period of years requires a significant amount of storage space and the film is usually expensive. An alternate method of storing photographs is to digitize the image with a PC and store the photograph on an optical laser disk drive. These disks are based on a write once read many times (WORM) technol-

ogy and cannot be erased or overwritten. Each 5-1/4" disk can store 400 Mbytes of data, or about 1600 photographs, at approximately 5% of the cost of standard 4" x 5" instant film.

2744 **(N—87-26511) Benchmarking hypercube hardware and software.** Grunwald, D.C.; Reed, D.A. (Illinois Univ., Urbana (USA)). Nov 1986. 19p. (NASA-CR—180620; NAS—1.26:180620; UIUCDCS-R—86-1303; UILU-ENG—86-1768). NTIS, PC A02/MF A01.

It was long a truism in computer systems design that balanced systems achieve the best performance. Message passing parallel processors are no different. To quantify the balance of a hypercube design, an experimental methodology was developed and the associated suite of benchmarks was applied to several existing hypercubes. The benchmark suite includes tests of both processor speed in the absence of internode communication and message transmission speed as a function of communication patterns.

2745 **(N—87-26512) MPF: a portable message passing facility for shared memory multiprocessors.** Malony, A.D.; Reed, D.A.; Mcguire, P.J. (Illinois Univ., Urbana (USA)). 1987. 25p. (NASA-CR—180631; NAS—1.26:180631). NTIS, PC A02/MF A01.

The design, implementation, and performance evaluation of a message passing facility (MPF) for shared memory multiprocessors are presented. The MPF is based on a message passing model conceptually similar to conversations. Participants (parallel processors) can enter or leave a conversation at any time. The message passing primitives for this model are implemented as a portable library of C function calls. The MPF is currently operational on a Sequent Balance 21000, and several parallel applications were developed and tested. Several simple benchmark programs are presented to establish interprocess communication performance for common patterns of interprocess communication. Finally, performance figures are presented for two parallel applications, linear systems solution, and iterative solution of partial differential equations.

2746 **(N—87-26515) Novel parallel architectures and algorithms for linear algebra processors. Progress report.** Casasent, D. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Apr 1987. 160p. (NASA-CR—180625; NAS—1.26:180625). NTIS, PC A08/MF A01.

Number representations, processing architectures and algorithms, optical linear algebra processor fabrication and test results, case study descriptions, and future system plans are covered.

2747 **(N—87-26516) Functional programming interpreter. M.S. thesis.** Robison, A.D. (Illinois Univ., Urbana (USA)). Mar 1987. 65p. (NASA-CR—180618; NAS—1.26-180618; UIUCDCS-R—87-1327; UILU-ENG—87-1714). NTIS, PC A04/MF A01.

Functional Programming (FP) sup BAC87 is an alternative to conventional imperative programming languages. This thesis describes an FP interpreter implementation. Superficially, FP appears to be a simple, but very inefficient language. Its simplicity, however, allows it to be interpreted quickly. Much of the inefficiency can be removed by simple interpreter techniques. This thesis describes the Illinois Functional Programming (IFP) interpreter, an interactive functional programming implementation which runs under both MS-DOS and UNIX. The IFP interpreter allows functions to be created, executed, and debugged in an environment very similar to UNIX. IFP's speed is competitive with other interpreted languages such as BASIC.

2748 **(N—87-26518) Parallel algorithm for channel routing on a hypercube.** Brouwer, R.; Banerjee, P. (Illinois Univ., Urbana (USA)). 1987. 12p. (NASA-CR—180563; NAS—1.26:180563). NTIS, PC A02/MF A01.

A new parallel simulated annealing algorithm for channel routing on a P processor hypercube is presented. The basic idea used is to partition a set of tracks equally among processors in the hypercube. In parallel, P/2 pairs of processors perform displacements and exchanges of nets between tracks, compute the changes in cost functions, and accept moves using a parallel annealing criteria. Through the use of a unique distributed data structure, it is possible to minimize message traffic and add versatility and efficiency in a parallel routing tool. The algorithm has been implemented and is being tested on some of the popular channel problems from the literature.

2749 **(N—87-26520) Force user's manual, revised.** Jordan, H.F.; Benten, M.S.; Arenstorf, N.S.; Ramanan, A.V. (Colorado Univ., Boulder, (USA). Cooperative Inst. for Research in Environmental Sciences). Jun 1987. 33p. (NASA-CR—180964; NAS—1.26:180964). NTIS, PC A03/MF A01.

A methodology for writing parallel programs for shared memory multiprocessors has been formalized as an extension to the Fortran language and implemented as a macro preprocessor. The extended language is known as the Force, and this manual describes how to write Force programs and execute them on the Flexible Computer Corporation Flex/32, the Encore Multimax and the Sequent Balance computers. The parallel extension macros are described in detail, but knowledge of Fortran is assumed.

2750 **(N—87-26531) Frontiers of massively parallel scientific computation.** Fischer, J.R. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1987. 293p. (NASA-CP—2478; REPT—87B9876; NAS—1.55:2478; CONF-8609343—). NTIS, PC A13/MF A01.

From Conference on frontiers of massively parallel scientific computation; Greenbelt, MD, USA (24 Sep 1986).

Practical applications using massively parallel computer hardware first appeared during the 1980s. Their development was motivated by the need for computing power orders of magnitude beyond that available today for tasks such as numerical simulation of complex physical and biological processes, generation of interactive visual displays, satellite image analysis, and knowledge based systems. Representative of the first generation of this new class of computers is the Massively Parallel Processor (MPP). A team of scientists was provided the opportunity to test and implement their algorithms on the MPP. The first results are presented. The research spans a broad variety of applications including Earth sciences, physics, signal and image processing, computer science, and graphics. The performance of the MPP was very good. Results obtained using the Connection Machine and the Distributed Array Processor (DAP) are presented.

2751 **(N—87-26569) Data analysis and software support for the Earth radiation budget experiment.** Edmonds, W.; Natarajan, S. (ST Systems Corp., Hampton, VA (USA)). Aug 1987. 91p. (NASA-CR—178350; NAS—1.26:178350). NTIS, PC A05/MF A01.

Computer programming and data analysis efforts were performed in support of the Earth Radiation Budget Experiment (ERBE) at NASA/Langley. A brief description of the ERBE followed by sections describing software development and data analysis for both prelaunch and postlaunch instrument data are presented.

2752 **(N—87-26570) Bibliography on parallel and vector numerical algorithms. Final report.** Ortega, J.M.; Voigt, R.G. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jul 1987. 125p. (NASA-CR—178335; ICASE—3; NAS—1.26:178335). NTIS, PC A06/MF A01.

This is a bibliography of numerical methods. It also includes a number of other references on machine architecture, programming language, and other topics of interest to scientific computing. Certain conference proceedings and anthologies which have been published in book form are listed also.

2753 **(N—87-26573) PISCES 2 parallel programming environment. Final report.** Pratt, T.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jul 1987. 16p. (NASA-CR—178327; ICASE—87-38; NAS—1.26:178327). NTIS, PC A02/MF A01.

PISCES 2 is a programming environment for scientific and engineering computations on MIMD parallel computers. It is currently implemented on a flexible FLEX/32 at NASA Langley, a 20

processor machine with both shared and local memories. The environment provides an extended Fortran for applications programming, a configuration environment for setting up a run on the parallel machine, and a run-time environment for monitoring and controlling program execution. This paper describes the overall design of the system and its implementation on the FLEX/32. Emphasis is placed on several novel aspects of the design: the use of a carefully defined virtual machine, programmer control of the mapping of virtual machine to actual hardware, forces for medium-granularity parallelism, and windows for parallel distribution of data. Some preliminary measurements of storage use are included.

2754 **(NUREG/BR—0103-Vol.3-No.3) ICAP [International Code Assessment and Applications Program] RELAP5 Newsletter.** (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA)). Jul 1987. Contract AC07-76ID01570. 21p. (EGG-RTH—7280(7-87)). NTIS, PC A02/MF A01 - GPO. Order Number DE88001680/JAW.

This newsletter is published on a quarterly basis by the United States Nuclear Regulatory Commission (USNRC). The topics in this issue are: Code changes; Programs supporting assessments and applications; Code performance problems and status; User bulletin board; Bibliography; and Documentation changes. (FI)

2755 **(ORNL/TM—10486) User interface for a partially incompatible system software environment with non-ADP users.** Loffman, R.S. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88001518/JAW.

Good user interfaces to computer systems and software applications are the result of combining an analysis of user needs with knowledge of interface design principles and techniques. This thesis reports on an interface for an environment: (a) that consists of users who are not computer science or data processing professionals; and (b) which is bound by predetermined software and hardware. The interface was designed which combined these considerations with user interface design principles. Current literature was investigated to establish a baseline of knowledge about user interface design. There are many techniques which can be used to implement a user interface, but all should have the same basic goal, which is to assist the user in the performance of a task. This can be accomplished by providing the user with consistent, well-structured interfaces which also provide flexibility to adapt to differences among users. The interface produced used menu selection and command language techniques to make two different operating system environments appear similar. Additional included features helped to address the needs of different users. The original goal was also to make the transition between the two systems transparent. This was not fully accomplished due to software and hardware limitations.

2756 **(ORNL/TM—10493) Foundations of O-theory 2: Measurements and relation to fuzzy set theory.** Oblow, E.M. (Oak Ridge National Lab., TN (USA)). 8 Jul 1987. Contract AC05-84OR21400. 38p. (CESAR—87/24). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000013/JAW.

A conceptual experimental framework for O-theory and the possibility form of fuzzy set theory is presented. The framework is probabilistic and derived from experimental measurements of evidential support. It is used to quantify the probabilistic masses needed in O-theory and the membership functions used in fuzzy set theory. Instances in which these two different representations of the same experimental data are equivalent are then explored. The relationships between general operators in both theories are then discussed, along with their connection to Dempster-Shafer theory. Finally, several illustrative examples of deductive inferencing under uncertainty are solved. The equivalence of the representations of the results in both uncertainty theories is demonstrated. 16 refs., 5 figs.

2757 **(ORNL/TM—10550) Supertracks: The building blocks of chaos.** Oblow, E.M. (Oak Ridge National Lab., TN (USA)). 25 Aug 1987. Contract AC05-84OR21400. 30p. (CESAR—87/39). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001513/JAW.

A theoretical conjecture is made about the nature of chaotic behavior in systems with simple maps. This conjecture gives rise to a computational scheme based on trajectories starting from the maximum in the system map. These trajectories are called supertracks and their loci in the parameter phase-space indexed by iteration number are called supertracks functions. The chaotic regimes of two nonlinear systems with a single maximum are studied using this scheme. It is found that the behavior in these regimes can be characterized recursively by supertrack functions. At low recursion order these functions analytically describe the gross features of the chaotic regime (i.e. bounding envelopes, stable cycles, star points, etc.). They can be iterated to higher orders to study higher order features. The methodology employed is general enough to be used to study other nonlinear systems. It also has potential for identifying chaotic behavior experimentally. Universality is the basis for theoretically understanding the results.

2758 **(ORNL/TM—10581) QR factorization of a dense matrix on a shared-memory multiprocessor.** Chu, E.; George, A. (Oak Ridge National Lab., TN (USA)). Oct 1987. Contract AC05-84OR21400. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001506/JAW.

A new algorithm for computing an orthogonal decomposition of a rectangular m x n matrix A on a shared-memory parallel computer is described. The algorithm uses Givens rotations, and has the feature that its synchronization cost is low. In particular, for a multiprocessor having p processors, an analysis of the algorithm shows that this cost is $O(n^2/p)$ if $m/p \geq n$, and $O(mn/p^2)$ if $m/p < n$. Note that in the latter case, the synchronization cost is smaller than $O(n^2/p)$. Therefore, the synchronization cost of the algorithm proposed in this article is bounded by $O(n^2/p)$ when $m \geq n$. This is important for machines where synchronization cost is high, and when $m >> n$. Analysis and experiments show that the algorithm is effective in balancing the load and producing high efficiency (speed-up). 13 refs.

2759 **(SAND—87-0903) Two classes of preconditioners computed using block matrix factorization techniques.** Baca, L.S.; Salane, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88001313/JAW.

Two methods for computing preconditioners for nonsymmetric block tridiagonal systems of linear equations are investigated. Adaptable general purpose implementations are given for both methods. 11 refs.

2760 **(SAND—87-2386C) ANVIL-5000 1.1.1 NC programming update.** Plomp, P.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 34p. (CONF-8710167—1). NTIS, PC A03. Order Number DE88001363/JAW.

From CIM SUBWOG/IMOG meeting; Golden, CO, USA (13 Oct 1987).

ANVIL-5000 is used effectively by the staff in Sandia's Materials Process Engineering and Fabrication Directorate to develop training materials, solve mathematics problems, prepare documentation, and program machines. The computational graphics resources are reviewed, the techniques for training the craftworker staff to use ANVIL are described, and a variety of current ANVIL applications are documented. Complex ANVIL projects involving a propeller blade mold and a water cooled head are described to illustrate the utility of CAD/CAM techniques being used by the NC Engineering staff. 30 figs.

2761 **(UCID—21189) Generating meshes for finite-difference analysis using a solid modeler.** Laguna, G.W.; White, W.T.; Cabral, B.K. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001458/JAW.

One tool used by the Engineering Research Division of LLNL to help analyze the behavior of electronic systems in hostile environments is 3D finite-difference time-domain (FDTD) computation. FDTD codes solve Maxwell's equations,the differential

equations of electromagnetism, on a uniform lattice of points. It is this uniform lattice, or "mesh," that distinguishes finite-difference codes from other codes. The simple mesh makes FDTD codes computationally more efficient than other codes, which enables them to run larger problems and to run faster (up to thirty times faster than finite-element codes, for example). Therefore, within the Engineering Department at LLNL, Electronics Engineering (EE) has initiated a project to develop a mesh generator that will provide meshes suitable for FDTD analysis. This report describes the results of the first year of EE's FDTD Mesh Generation Project. During this year a preliminary version of an automated mesh generator was built and used to create a mesh of an object of interest to the High-Power Microwave Program, namely an electrically detonatable land mine. The code was verified by meshing basic solids such as spheres and cylinders. Because of the design of the code, there is no software limitation to the size of meshes that can be accommodated. The algorithm with a mesh space of approximately 500,000 cells has been demonstrated. The mesh generator can detect certain objects with walls that are thinner than the width of a cell. The code has internal graphics for viewing objects as they appear prior to being converted to a finite-difference representation. Additionally, via data files, the code is coupled to two external graphics packages for visually checking the meshes, namely TAURUS on the Cray and a new code, IMAGE, on the Silicon Graphics IRIS workstation.

2762 **(UCID—21193) COLA2: A computer program for the structural synthesis of two components using general modal coordinates.** Bumpus, S. (Lawrence Livermore National Lab., CA (USA)). 14 Aug 1987. Contract W-7405-ENG-48. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001457/JAW.

The COLA2 computer program was developed as part of the Mechanical Engineering Research Project named "Structural Control Technology Research". This computer program was developed because of the need to perform substructured modeling within the research project. COLA2 performs a component mode synthesis for two linear elastic components using modes that are more general than the structural eigenmodes; that is, Lanczos coordinates eigenmodes, static vectors, or other vectors for mode reduction can be used. Data for COLA2 is calculated using the GEMINI linear elastic finite element computer code. Besides the synthesis capability, COLAS also has a dynamic response simulation capability that may be executed concurrently with the component mode synthesis or with a restart execution. COLA2 can be executed on the CRAY-1 computers at the Livermore Computer Center. An example showing the component model synthesis for a two-dimensional problem is presented along with the associated modal time history simulation. Another example, which is performed using the GEMINI code but which is capable of being performed with COLA2 given a two-component modal representation, is also presented to show simulation capabilities that use constant gain control forces. 10 refs., 9 figs., 5 tabs.

2763 **(UCRL—93464) Guidelines for the syntactic design of audio cues in computer interfaces.** Sumikawa, K.A.; Blattner, M.M.; Joy, K.I.; Greenberg, R.M. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA); Anderson (M.D.) Hospital and Tumor Inst., Houston, TX (USA). Dept. of Biomathematics). 3 Oct 1985. Contract W-7405-ENG-48. 11p. (CONF-860107—1). NTIS, PC A02. Order Number DE87008737/JAW.

From 19. annual Hawaii international conference on system sciences; Honolulu, HI, USA (8 Jan 1986).

A logical next step in the evolution of the computer/user interface is the incorporation of sound, thereby using the sense of hearing in our communication with the computer. This allows our visual and auditory capacities to work in unison, which produces a more effective and efficient interpretation of information received from the computer than sight alone. In this paper we examine earcons, which are audio cues used in the computer/user interface to provide information and feedback to the user about computer entities. (Earcons include messages and functions, as well as states and labels.) Here we present design guidelines for the syntax of earcons. Earcons are constructed from pitches, rhythms, and motives, short sequences of notes with a specific rhythm and pitch, embellished by timbre, dynamics, and register. Compound earcons and family earcons are introduced. These are related motives that serve to identify a family of related cues. Examples of earcons are given. 18 refs.

2764 **Schwarz—Christoffel mappings: A general approach.** Floryan, J.M.; Zemach, C. (Faculty of Engineering Science, The University of Western Ontario, London, Ontario, Canada N6A 5B9). *Journal of Computational Physics;* 72: No. 2, 347-371(Oct 1987).

A general method is developed for constructing equations of the Schwarz—Christoffel type. These equations define conformal transformations between regions of the complex plane, each of whose boundaries may consist of straight or continuously curved line segments and corners. The more familiar types of Schwarz—Christoffel equations are rederived, and some new types are obtained. copyright 1987 Academic Press, Inc.

2765 **Rapidly convergent method for the inversion of separable, positive, self-adjoint discrete elliptic operators in three or more dimensions.** Siggia, E.D.; Pumir, A. (Computing and Telecommunications Division, Oak Ridge National Laboratory, Oak ridge, Tennessee 37831). *Journal of Computational Physics;* 72: No. 2, 498-500(Oct 1987). Contract AC02-83ER13044.

An algorithm for solving the Poisson equation in separable coordinates is presented. (AIP) copyright 1987 Academic Press, Inc.

2766 **New convergence estimates for multigrid algorithms.** Bramble, J.H.; Pasciak, J.E. (Itek Optical Systems, Litton Industries, 10 Maguire Road, Lexington, Massachusetts 02173). *Mathematics of Computation;* 49: No. 180, 311-329(Oct 1987).

In this paper, new convergence estimates are proved for both symmetric and nonsymmetric multigrid algorithms applied to symmetric positive definite problems. Our theory relates the convergence of multigrid algorithms to a "regularity and approximation" parameter $\alpha \in (0, 1]$ and the number of relaxations m. We show that for the symmetric and nonsymmetric ν cycles, the multigrid iteration converges for any positive m at a rate which deteriorates no worse than 1-cj/sup -(1-//sup α//sup)///sup α/, where j is the number of grid levels. We then define a generalized ν cycle algorithm which involves exponentially increasing (for example, doubling) the number of smoothings on successively coarser grids. We show that the resulting symmetric and nonsymmetric multigrid iterations converge for any α with rates that are independent of the mesh size. The theory is presented in an abstract setting which can be applied to finite element multigrid and finite difference multigrid methods.

2767 **Numerical solution of stochastic differential equations with constant diffusion coefficients.** Chien-Cheng Chang. (Itek Optical Systems, Litton Industries, 10 Maguire Road, Lexington, Massachusetts 02173). *Mathematics of Computation;* 49: No. 180, 523-542(Oct 1987).

We present Runge-Kutta methods of high accuracy for stochastic differential equations with constant diffusion coefficients. We analyze L_a convergence of these methods and present convergence proofs. For scalar equations a second-order method is derived, and for systems a method of order one-and-one-half is derived. We further consider a variance reduction technique based on Hermite expansions for evaluating expectations of functions of sample solutions. Numerical examples in two dimensions are presented.

2768 **On the characterization of q-superlinear convergence of quasi-Newton methods for constrained optimization.** Stoer, J.; Tapia, R.A. (Itek Optical Systems, Litton Industries, 10 Maguire Road, Lexington, Massachusetts 02173). *Mathematics of Computation;* 49: No. 180, 581-584(Oct 1987).

In this paper we present a short, straightforward and self-contained derivation of the Boggs-Tolle-Wang characterization of those, quasi-Newton methods for equality-constrained optimization which produce iterates which are q-superlinearly convergent.

2769 **Table of elliptic integrals of the second kind.** Carlson, B.C. (Itek Optical Systems, Litton Industries, 10 Maguire Road, Lexington, Massachusetts 02173). *Mathematics of Computation;* **49**: No. 180, 595-606(Oct 1987).

By evaluating elliptic integrals in terms of standard R-functions instead of Legendre's integrals, many (in one case 144) formulas in previous tables are unified. The present table includes only integrals of the first and second kinds having integrands with real singular points. The 216 integrals of this type listed in Gradshteyn and Ryzhik's table constitute a small fraction of the special cases of 13 integrals evaluated here. The interval of integration is not required, as it is in previous table, to begin or end at a singular point of the integrand. Fortran codes for the standard R-functions are included in a Supplement.

2770 **On the performance of some rapid elliptic solvers on a vector processor.** Kightley, J.R.; Thompson, C.P. (Computer Science and Systems Div., Harwell Lab., UKAEA, Oxfordshire OX11 0RA). *SIAM Journal on Scientific and Statistical Computing;* **8**: No. 5, 701-715(Sep 1987).

This paper compares the performance of two software packages which use multigrid techniques, together with the preconditioned conjugate gradient method and direct methods, for solving certain classes of elliptic partial differential equations. The advantages and drawbacks of each code are discussed, and indication given of the circumstances in which each type of code will work efficiently on a CRAY-1 computer and on a conventional serial processor.

2771 **Two multigrid methods for three-dimensional problems with discontinuous and anisotropic coefficients.** Dendy, J.E. Jr. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). *SIAM Journal on Scientific and Statistical Computing;* **8**: No. 5, 673-685(Sep 1987). Contract W-7405-ENG-36.

The subject of this paper is two multigrid methods for the numerical solution of -del . (D(x,y,z)delU(x,y,z)) $+\sigma(x,y,z)U(x,y,z)=F(x,y,z)$ in a bounded region Ω or R/sup 3/, where D = (D/sup 1/, D/sup 2/, D/sup 3/), D/sup i/ is positive, i - 1,2,3, and D/sup i/, σ, and F are allowed to be discontinuous across internal boundaries of Ω. The first method differs in two important ways from previously considered multigrid methods for such problems; first, if standard coarsening is used, then anisotropic problems require plane relaxation to obtain a good smoothing factor; for problems with discontinuous coefficients, this was previously done with an ICCG method; here it is done with a two-dimensional multigrid method. Second, a slightly different form of interpolation is used which improves performance for nearly singular problems. Previously considered multigrid methods for problems with discontinuous coefficients have defined the coarse grid operators by Galerkin coarsening; in the second method, such coarsening is also used but with auxiliary intermediate grids obtained by semi-coarsening successively in each of the three independent variables; this artifice simplifies coding considerably and results in comparable convergence.

2772 **A high-order method for stiff boundary value problems with turning points.** Brown, D.L.; Lorenz, J. (Los Alamos National Lab., Center for Nonlinear Studies and Computing Div., Los Alamos, NM 87545). *SIAM Journal on Scientific and Statistical Computing;* **8**: No. 5, 790-805(Sep 1987). Contract AS03-76ER72012.

This paper describes some high-order collocation-like methods for the numerical solution of stiff boundary-value problems with turning points. The presentation concentrates on the implementation of these methods in conjunction with the implementation of the a priori mesh construction algorithm for such problems. Numerical examples are given showing the high accuracy which can be obtained in solving the boundary value problem for singularly perturbed ordinary differential equations with turning points.

2773 **Performance of various computers using standard linear equations software in a Fortran environment.** Dongarra, J.J. (Mathematics and Computer Science Div., Argonne National Lab., Argonne, IL 60439). *Simulation;* **49**: No. 2, 51(Aug 1987). Contract W-31-109-ENG-38.

This note compares the performance of different computer systems while solving dense systems of linear equations using the LINPACK software in a Fortran environment. About 100 computers, ranging from a CRAY X-MP to the 68000-based systems such as the Apollo and SUN Workstations to IBM PC's, are compared.

2774 **Selecting a random sample of points in circular field plots.** Skalski, J.R. (Battelle, Pacific Northwest Lab., Sequim, WA). *Ecology;* **68**: No. 3, 749(Jun 1987). Contract AC06-76RL01830.

Fields ecologists frequently use circular plots in the study of terrestrial, aquatic, and marine systems. A common motivation for using such plots is the relative ease of identifying sample locations over large areas based on a series of distance and angle measurements from the plot center. Unfortunately, investigators often wrongly assume that selecting random angle measurements from 0^{0}-360^{0} and random distances from O-R (= the radius of the circular plot) will produce a random sample from the area within the circular plot. The purpose of this note is to present a modification of this angle instance technique which assures a random areal sample.

2775 **Multi-processor including data flow accelerator module.** Davidson, G.S.; Pierce, P.E. (to Dept. of Energy). US Patent Application 6-003,540. 15 Jan 1987. 82p. Contract AC04-76DP00789. DE88000859 NTIS, PC A05. Order Number DE88000859/JAW.

An accelerator module for a data flow computer includes an intelligent memory. The module is added to a multiprocessor arrangement and uses a shared tagged memory architecture in the data flow computer. The intelligent memory module assigns locations for holding data values in correspondence with arcs leading to a node in a data dependency graph. Each primitive computation is associated with a corresponding memory cell, including a number of slots for operands needed to execute a primitive computation, a primitive identifying pointer, and linking slots for distributing the result of the cell computation to other cells requiring that result as an operand. Circuitry is provided for utilizing tag bits to determine automatically when all operands required by a processor are available and for scheduling the primitive for execution in a queue. Each memory cell of the module may be associated with any of the primitives, and the particular primitive to be executed by the processor associated with the cell is identified by providing an index, such as the cell number for the primitive, to the primitive lookup table of starting addresses. The module thus serves to perform functions previously performed by a number of sections of data flow architectures and coexists with conventional shared memory therein. A multiprocessing system including the module operates in a hybrid mode, wherein the same processing modules are used to perform some processing in a sequential mode, under immediate control of an operating system, while performing other processing in a data flow mode.

2776 **Development and implications of a software-based residential energy conservation standard.** Lee, A.D.; Pratt, R.G. (Battelle Pacific Northwest Lab., Richland, WA, USA). pp 181-192 of Strategic planning in energy and natural resources. Lev, B. (ed.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (North-Holland) (1987). (CONF-8604185—).

From 2. symposium on analytic techniques for energy, natural resources, and environmental planning; Philadelphia, PA, USA (3 Apr 1986).

Development and implications of the recently completed Federal Residential Conservation Standard, uniquely software-based, are described and discussed. By law, the Department of Energy is required to develop and issue energy conservation performance standards for residential buildings. Federal agencies that procure housing will implement the standard. The objectives for the standard were to: provide performance-based requirements, use cost-effectiveness criteria, accomodate local and changing conditions, and maximize ease of use. A software-based format seemed singularly able to achieve these objectives. The program is described and samples of its output are illustrated. Next, issues related to the acceptability of a software-based standard are discussed. Public review and comment should help reveal and evaluate advan-

tages, disadvantages, and potential problems of using a software format for standards, and should help assess the potential for software-based standards in the private sector.

2777 **Testing logical matrices with the help of an automated reasoning program.** Kalman, J.A. (Argonne National Lab., Argonne, IL 60439-4844). pp 276-281 of Proceedings of the seventeenth international symposium on multiple valued logic. Piscataway, NJ; IEEE Service Center (1987). (CONF-8705139—).

From 17. international symposium on multiple valued logic; Boston, MA, USA (26 May 1987).

This paper applies automated reasoning to test whether logical matrices satisfy propositional formulas, and discusses certain related questions. It is shown how to represent such questions in first-order logic, so that they may be investigated by an automated reasoning program whose facilities include hyperresolution and demodulation. Techniques are given for specifying a logical matrix to such a program, for testing a logical matrix to see if it satisfies a set of propositional formulas, and for testing a logical matrix to ascertain whether it is normal or not. Appendices reproduce files that have actually been used to test logical matrices by the automated reasoning program ITP.

2778 **Extending an object-oriented alarm-filtering system.** Corsberg, D. (EG and G Idaho, Inc., Idaho Falls, ID). pp 80-87 of Proceedings of expert systems in government symposium. Karna, K.N.; Parsaye, K.; Silverman, B.G. Piscataway, NJ; IEEE Service Center (1986). (CONF-8610145—).

From 2. expert systems in government conference; McLean, VA, USA (20 Oct 1986).

An alarm-filtering system (AFS) developed by EG and G Idaho, Inc. for the Advanced Test Reactor (ATR) at the Idaho National Engineering Laboratory is described in this paper, as well as how that 'shallow' knowledge system can be used as a basis for a more powerful ('deep' knowledge) system that would handle conflicts and verify conclusions. Methods of alarm analysis are investigated based on functional relationships (rather than a historical approach using cause-consequence trees) and artificial intelligence techniques are demonstrated as useful in analyzing alarms and alarm sequences.

2779 **A LISP-based fault tree development environment.** Dixon, B.W. (EG and G Idaho, Inc., Idaho Falls, ID). pp 159-167 of Proceedings of expert systems in government symposium. Karna, K.N.; Parsaye, K.; Silverman, B.G. Piscataway, NJ; IEEE Service Center (1986). (CONF-8610145—).

From 2. expert systems in government conference; McLean, VA, USA (20 Oct 1986).

This paper describes an integrated graphical environment which can be used to build, modify, and analyze fault trees in a stand-alone work-station. The environment is written in LISP, utilizing graphics and menu features commonly found on LISP workstations. A unique fault tree solution algorithm is presented that efficiently utilizes a list-based tree structure and search space, and rule-based pruning to allow for rapid analysis of larger trees. Design and efficiency issues are discussed.

9903 Information Handling

REFER ALSO TO CITATION(S) 2341, 2674, 2710

2780 **(INIS-BR—694) Computer modes for water physic properties under LWR conditions.** Oleron Vasconcelos, A. de. (Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear). 1986. 43p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703454/JAW.

Aiming to develop thermohydraulic computer codes for core reactor analysis of a power reactor, in steady, and transient processes, computer modes for automatizing calculations of the physic properties of water under pressure were done. The equations were written in computer language and the quality of resultant deviation was analysed by the table of the thermodynamic properties. (M.C.K.).

2781 **(JAERI-M—87-097) JT-60 database system. 1. Basic concept and system design.** Kurihara, Kenichi; Kimura, Toyoaki; Itoh, Yasuhiro. (Japan Atomic Energy Research Inst., Tokyo). Jul 1987. 58p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750314/JAW.

Naturally, sufficient software circumstance makes it possible to analyse the discharge result data effectively. JT-60 discharge result data, collected by the supervisor, are transferred to the general purpose computer through the new linkage channel, and are converted to "database". Datafile in the database was designed to be surrounded by various interfaces. This structure is able to preserve the datafile reliability and does not expect the user's information about the datafile structure. In addition, the support system for graphic processing was developed so that the user may easily obtain the figures with some calculations. This paper reports on the basic concept and system design.

2782 **(LBL—23656) Networking requirements and future alternatives.** Brown, A.; Fath, A.F.; Fitzgerald, J.; Gross, P.; Hall, D.; Haverty, J.; Kennedy, C.M.; Lasinski, T.; McClain, F.; McGregor, P. (Cornell Univ., Ithaca, NY (USA); Boeing Computer Services Co., Seattle, WA (USA); Lawrence Livermore National Lab., CA (USA); Mitre Corp., McLean, VA (USA); Lawrence Berkeley Lab., CA (USA); BBN Communications Corp., Cambridge, MA (USA)). Jun 1987. Contract AC03-76SF00098;W-7405-ENG-48;AC02-76CH03000. 18p. (CONF-870277—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000465/JAW.

From Federal Coordinating Council on science, engineering and technology; San Diego, CA, USA (17 Feb 1987).

The Working Group on Networking Requirements and Future Alternatives recommends creation of an international, interagency networking facility for science, whose 15-year mission is to ensure that US scientists have available the most advanced wide area networking facilities in the world, and to ensure that US wide area network technology maintains a position of world leadership. A minimum of 1.5-Mbit/s access to major government and academic research centers should be provided. Such a network would greatly benefit the competitive position of the United States in scientific research. It would also place the US in a leadership position in utilization of high bandwidth, wide area networks. United States industries supporting wide area network technologies would gain a significant competitive advantage over other countries. An ongoing program of research and development into both wide area network technology and network management is necessary for this endeavor to be successful. As part of the second year study, the Working Group recommends that an interagency coordinating committee be established to identify short-term implementation issues that can be investigated and resolved in parallel with long-term issues. This would provide immediate benefit to the nation's scientific community.

2783 **(LBL—23861) Managing distributed derived data: A preliminary proposal.** Murphy, M.C. (Lawrence Berkeley Lab., CA (USA); San Francisco State Univ., CA (USA). Dept. of Computer Science). Aug 1987. Contract AC03-76SF00098. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000714/JAW.

This paper introduces a new class of distributed data: derived data. Derived data is information which is generated from and/or describes source data and algorithms. Derived data differs from source data in that typically it can be regenerated whenever it is needed, or generated then stored for later use. Stored derived data may become outdated as a result of update activity to the underlying source data, however it may still be accurate enough for its intended application. In this preliminary proposal we describe several major classes of derived data, then develop a general framework for maintenance in a distributed environment.

2784 **(ORNL/TM—10385) Machine readable identification systems: An overview.** Smith, F.J.; Cantor, S. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001523/JAW.

The application of automated identification of an item by the use of machine readable methods is improving the accuracy and speed of data capture. Bar codes, optical character recognition, magnetic stripe, and magnetic-ink recognition are all current machine readable methods which are used for data collection. Bar code data collection is the most used technology for real time inventory control, tracking, and point of sale applications. Magnetic strip coding is used for highly compact data identification on ID cards and on tags. Optical character recognition is generally used today to capture documents for computer storage and recall. Magnetic-ink character recognition, though used widely in banking, has limited applications elsewhere. Bar code methods are currently experiencing a faster rate of growth than the other technologies. Emphasis of this paper is on bar coding because of its popularity. The fundamentals of bar coding are discussed and labeling and scanning techniques are presented. New, automatic data-collection techniques are being developed, utilizing microcircuits and compact-disk memory media. The greatly increased memory capacity of these systems will likely lead to identification in terms of definitive characteristics of the item.

2785 **(PNL—6318) User manual for the Hanford Energy Conservation Project data base.** Humphreys, K.K.; Fassbender, L.L.; Weakley, S.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000666/JAW.

The Hanford Energy Conservation (HEC) Project Data Base developed by the Pacific Northwest Laboratory for the US Department of Energy's Richland Operations Office, provides a centralized storehouse of information on planned and ongoing projects which are part of the HEC project. The data base will enable quick analysis of the project portfolio. The data base uses dBase III Plus on an IBM PC. Over 40 data items are stored for each project. A menu-driven applications program was developed as an alternative to using standard dBase III Plus commands. The menu-driven program prompts the user to add data, edit data, perform on-screen searches of the data base, sort the data base by any variable or combination of variables, or generate hard-copy reports of the stored data.

2786 **(PNL-SA—15189) On computing environments in data analysis.** Nicholson, W.L.; Carr, D.B. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 15p. (CONF-870984—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000078/JAW.

From 46. session of the International Statistical Institute; Tokyo, Japan (8 Sep 1987).

The paper presents the perspective of two data analysts on computing environments. The perspective focuses attention on general functional capabilities, computing interfaces and the evolution of computing environments. The paper notes the lack of involvement of data analysts in the evolution of general computing environments. Rather data analysts have been primarily relegated to adapting general-purpose tools. The suggestion is made that data analyst/computer-scientist teams work with those engaged in state-of-the-art research and participate on standards committees so that emerging general computing environments include tools well suited to data analysis.